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DISTRICT OF PATRICIA

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REPORTS ON THE

DISTRICT OF PATRICIA

RECENTLY ADDED TO THE PROVINCE OF ONTARIO

COMPILED AND EDITED WITH AN INTRODUCTION

By WILLET G. MILLER, Provincial Geologist

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THE DISTRICT OF PATRICIA

Introduction and Summary of Contents

By WILLET G. MILLER

That part of the district of Keewatin, added by Act of Parliament of Canada in 1912 to the territory of the Province of Ontario, and now known as the district of Patricia, consists of over 146,400 square miles.[1] Its area is about one and one-fifth times that of the British Isles, and nearly three-quarters of that of France or Germany. Heretofore the districts of the Province lying north of the main line of the Canadian Pacific Railway and lakes Huron and Superior contained approximately 182,900 square miles, or, excluding the water area of Lake Superior, 171,000, the whole of Ontario having had an area of about 260,862 square miles. The new district adds over 56 per cent. to the area of the Province.

According to statistics published by the Department of the Interior, the three largest Provinces of the Dominion now are Quebec, including Ungava, 706,834 square miles; Ontario, 407,262, and British Columbia, 357,600.

The district of Patricia is bounded on the west and northwest by the Province of Manitoba, on the south and southeast by the English and Albany rivers, and on the east and north by James and Hudson bays. Ontario now has a seashore of over 600 miles in length.

From time to time during the last forty years the Geological Survey of Canada has sent parties to explore and report on that part of the district of Keewatin to which the name Patricia has been given. Much valuable information has been obtained by these parties, but, being scattered through the annual reports of the Geological Survey, many of which are out of print and difficult of access, it is not available to the public. Hence it was decided to collect and reprint the reports, with certain of their accompanying maps and illustrations, and to publish them in a single volume, so that officials of the Ontario Government, prospectors for minerals, and other persons visiting the district, can have in handy form practically all the information that has been obtained. This volume may be considered to be a library of the literature on the district. A few other sources of information have been drawn on, in addition to the reports of the Geological Survey.

The reports and extracts therefrom have been arranged, as far as possible, geographically in the following pages. First, descriptions of the Albany river and territory adjacent along the southern boundary are given. Then follow reports on the country lying farther to the northward. Certain reports, however, describe the country along waterways that cross the district in various directions. These reports cannot be

[1] Mr. W. R. Rogers, topographer of the Bureau of Mines, has kindly redetermined for me the size of the district of Patricia. According to his determination, using a planimeter on the map of the Department of the Interior, scale 100 miles to 1 inch, the district contains 157,100 square miles, including lakes and rivers.—W. G. M.

arranged in geographical sequence, but the index at the end of the volume shows on what pages scattered notes on different areas are to be found.

Instead of condensing certain of the reports it has been thought advisable to republish them *in extenso*. While some of the information contained in them is general in character, it may be found useful in the field.

Towards the end of the volume notes are given from reports concerning James and Hudson bays in general, and concerning the much-debated question as to the probable success, or otherwise, of the navigation of Hudson bay and straits.

It may be added that certain of the reports are not confined to the district of Patricia, but cover territory a little beyond the boundaries, belonging to Manitoba or lying south of the Albany river. Inasmuch as persons desiring to visit the district will have in many cases to pass through such territory, it is thought that such information, if published in the volume, will be useful.

In addition to those accompanying this volume, maps published by the Geological Survey of Canada should be consulted, viz., Nos. 239, 578, 814, 815, 846, 895, 915 and 9A.

The following summary of the contents of the reports may be of service. It is arranged under the headings:

(1) General Character of the District, (2) Geology, (3) Soil and Climate, (4) Forests, (5) Fish and Game, (6) Water Powers, (7) Harbours.

1.—GENERAL CHARACTER OF THE DISTRICT

The surface of the district of Patricia is in general much like that of the older northern districts of the Province, or those which lie north of the main line of the Canadian Pacific railway and south of the Albany river. In elevation, the presence of numerous watercourses and lakes, character of rocks, and, over a part of the district at least, the nature of the vegetation, it differs but little from the older districts. Extending farther northward there are certain differences in vegetation and in climate.

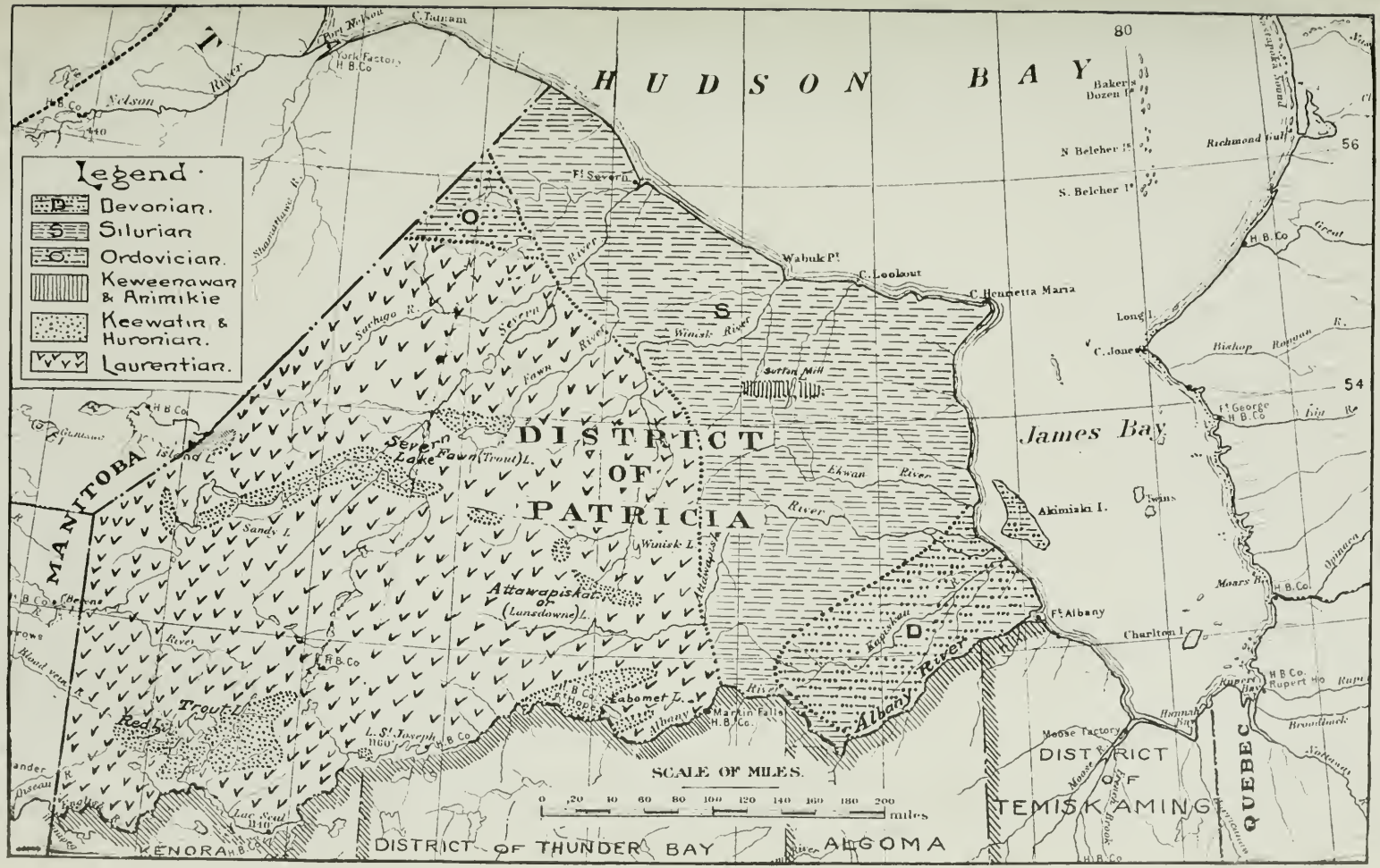
2.—GEOLOGY

The geology of the district presents about the same features as does that of the region which has hitherto been called Northern Ontario. The greater part of the district is underlain by rocks of pre-Cambrian age. However, along the coasts of James and Hudson bays, from the mouth of the Albany river to the Manitoba boundary, the rocks are of Paleozoic age. The accompanying geological sketch map shows the distribution of the various series. Maps that accompany reports on following pages give more details.

Little detailed geological work has been done in the district. The parties that have visited it have confined their attention practically to the water courses. In so far as can be judged from what is known of the geology, the district should contain important mineral deposits.

The Keewatin rocks, which occur in considerable volume, should furnish deposits of gold, iron and other ores such as are found with rocks of this age in other districts of Northern Ontario. Limestones, similar to those of the Hastings and Grenville series of southeastern Ontario, are found at Red lake and in a few other localities. Just south of Nibinamik lake, on a branch of the Winisk river, a large mass of hypersthene gabbro, similar to the nickel-bearing intrusive of Sudbury, occurs in a belt of Keewatin rocks.

Conglomerates of Lower or Middle Huronian age are apparently not present in great volume in the district, although they occur in association with the pre-Cambrian limestone of Red lake and are found in association with Keewatin rocks on Wunnummin lake on the Winisk river, and elsewhere. Rocks comparable to the Animikie, at the head of Lake Superior, or to the Nastapoka series of the east coast of Hudson bay, are found at Sutton Mill lake and outcropping through the Paleozoic on the Winisk river, twenty-six miles from its mouth. At the former locality they are intruded and overlain by diabase, thus giving rise to conditions similar to those which exist in the silver area at the head of Lake Superior or at Cobalt.



Geological Sketch Map of the District of Patricia.

The Animikie or Nastapoka rocks at Sutton Mill lake contain iron ore in such quantity as to justify the hope that deposits of the metal of economic value may be found in the district.

The Paleozoic rocks extending inland from the coast of James and Hudson bays are similar in age to those in the Erie-Huron peninsula of southern Ontario and may, therefore, contain petroleum, natural gas, gypsum, salt and other valuable minerals.

On following pages many of the reports, especially those published some years ago, describe certain rocks as Huronian. In most cases they should be given the name Keewatin, since they consist of greenstones and other types of pre-Huronian age.

The name Keewatin when applied to rocks should not be confused with that of the district. In the former case it is used in an age sense, meaning the oldest group of rocks known in northern Canada. It was not introduced for rocks belonging to the district of Keewatin. The name, with different spelling, is familiar in the lines,

"Of the North-west Wind, Keewaydin,
Of the home-wind, the Keewaydin."

Numerous notes are given in the reports on the superficial geology, glacial and recent. Since this does not differ materially from that of other parts of Northern Ontario, comments on it are not required in these introductory notes.

3.—SOIL AND CLIMATE

There being such vast, undeveloped areas of good agricultural lands in other more readily accessible districts of Northern Ontario, the agricultural value of the district of Patricia is scarcely of immediate interest. The following extracts from reports show that the district does contain agricultural resources which will be valuable, especially locally, in connection with mines and other industries that may be established. The extracts also give an account of the summer climate of the district.

The following paragraphs are taken from reports by Mr. William McInnes and other writers, which will be found on succeeding pages. The name of the writer quoted is printed in italics after the quotation, which in some cases is given *verbatim*, and in others in condensed form or with grammatical alterations to suit the context.

A considerable variety in spelling, especially of proper names, is found in the reports. This is due to the fact that when the earlier reports were written the spelling of the Indian names of the lakes, rivers and other natural features had not been standardized.

Though, considered as a whole, the central, elevated region cannot be spoken of as generally adapted for agriculture, there occur basins covered by heavy deposits of stratified sand and clay that seem to have been laid down in lakes held in between barriers formed by the walls of the retreating glacier and ridges of drift. An examination of some of these clays by Dr. Hoffmann shows them to be highly calcareous and somewhat silicious, a composition that, with the admixture of the surface vegetable mould, should produce an excellent soil for general agriculture. The question of climate, which is, of course, of the utmost importance when considering the agricultural possibilities of a district, will be referred to more particularly in another place. It may be said here, however, that the climatic conditions are, if somewhat adverse, not by any means prohibitory to the general cultivation of suitably situated tracts.—(*McInnes.*)

Cultivation of the Land

In the matter of the actual cultivation of these northern areas, we have little to go upon. At the Hudson's Bay Company's posts at Fort Hope and Osnaburgh potatoes have been grown, and small gardens maintained from the time of the establishment of the posts, and little difficulty has been experienced in maturing the common garden vegetables of Ontario, though occasionally the frosts of late summer have cut off all but the hardier kinds. As the posts were located with a view to their favorable situation for the purpose of the fur trade with the Indians, neither one is situated on ground well suited for cultivation, and much better results might reasonably be expected were trials made on more favorably situated tracts.

An Indian cultivating a small garden plot at the head of the Pineimuta branch of the Attawapiskat river succeeds in raising good crops of potatoes and turnips.—(*McInnes.*)

Lake St. Joseph

It would be difficult to estimate the proportion of cultivable soil compared with the worthless area in the country adjacent to the shores of Lake St. Joseph, but the percentage does not appear to be great. In some places, both on the main shores and the larger islands, low banks of sand and of yellowish loam were seen, but, as a rule, the surface appears to be either too stony or too level and wet to give much promise as a farming region. The Indian name of Lake St. Joseph is "the lake of the swampy country."

The climate in the immediate vicinity of the lake, at all events, appears to be sufficiently good to admit of the growth of a variety of crops. At Osnaburgh House, near the east end, where the soil is of a sandy nature, the principal crop cultivated at present is potatoes, but early Indian corn, peas, beans, and a variety of roots and other vegetables, to say nothing of a profusion of flowers, were in a flourishing condition in the end of July. In former years, when cattle were kept at the post, barley was said to have been a regular crop. Hay grows very luxuriantly. I was credibly informed that pumpkins and muskmelons had frequently ripened at this establishment.

Martin's Falls, Albany River

When at Martin's Falls, Mr. McKay, the gentleman in charge of the Hudson Bay Company's post there, kindly afforded me an opportunity of looking over the journals of the last forty years, which had been kept by his predecessors. From these I ascertained that the river between this point and James bay is open, on an average, six months of the year. Hay, turnips and potatoes have been successfully cultivated for a long time at this post, and cattle kept there thrive well.—(*Bell.*)

Fort Albany

Gardening is carried on successfully at Moose and Albany. We never had better potatoes than those from Albany.—(*O'Sullivan.*)

Berens River Valley

The agricultural possibilities of this valley seem to be limited, and the areas suitable for cultivation are only to be found in isolated patches. These are principally in the neighborhood of the larger lakes. The Indian reserves have been located with this end in view, as they seem to cover about the best land seen. The soil is a light gray clay, with a little vegetable mould, and the gardens made by the Indians produce potatoes of fair quality, the only vegetable grown.—(*Dowling.*)

Severn River

Between Severn and Trout lakes, and for 100 miles down the Fawn river, the country is very flat and swampy, the timber being chiefly black spruce and tamarac of small size.

Beyond this, as far as the sea, the river cuts more deeply into the surface of the country, forming a valley, the banks of which are composed of sand and clay, and vary in elevation from 50 to 200 feet. Beyond the valley the soil appears light and poor, and in many places swampy, sustaining a small growth of black spruce and poplar.

Favourable Lake, Severn River

Favourable lake is very irregular in shape, the two portions forming a T, the stem of which lies north and south, with a crooked head stretching irregularly east and west. The width varies from two to five miles. Hills from fifty to one hundred and fifty feet high surround the lake, more than half the timber on which has been burnt. Along the shores there are considerable areas of good land, the best being on the peninsula and along the southern part of the lake, where the underlying rocks are hornblendic and chloritic schists; the northern portion is more barren, the soil resting on gneiss. The soil is a fine, rich, sandy loam, quite suitable for growing good crops, and summer frosts seem to be the only drawback to successful agriculture. These are said not to occur at Trout lake, though situated farther to the northeastward.

Trout Lake,[2] Severn River

Mr. Tait, the officer in charge of the post, says that good crops of peas, potatoes and other roots are raised here yearly, and are very rarely injured by summer frosts. This being the case, the country to the westward, between Severn and Sandy lakes, which is more favorably situated, having all the appearance of a better climate and a richer soil, must undoubtedly be well suited for agriculture, and will at some future time prove valuable land for settlement.

[2] Trout lake, on the Fawn river branch of the Severn, should not be confused with Trout lake in the southwest corner of the district which drains into the English river. There are other duplications of the names of lakes in the district, two on the Severn river being called Sandy.

Fort Severn

The soil around the post is a heavy clay and very swampy. The climate is so cold and the season so short that nothing but a few small turnips is grown here. On August 8th we picked strawberries on the clearings around the post; at that time they were only beginning to ripen.—(*Low.*)

4.—TIMBER

These notes on timber have been taken almost *verbatim* from reports on following pages. Since several of the reports were made from ten to twenty years ago, or more, timber in localities to which reference is made may have since been destroyed by fire. The notes are fragmentary, but it is hoped that they will serve the purpose of giving a general idea of the timber resources of the district. It should be borne in mind that the timber described is found chiefly along the better travelled routes, where it has been more subject to fire. The notes show that the district formerly contained more timber of merchantable grade than now, the constant recurrence of fires having brought about destruction of the forests in this as in the districts to the south. If protected in the future, the greater part of the district should furnish an important supply of timber. The northern limit of a number of the common trees of northern Canada falls within the district, and of one species both the northern and southern limits.

The notes are arranged in a general way, geographically, the more southern areas being described first and then the more northern.

Lac Seul to Red Lake and Part Berens River Basin

The country is well covered by timber, but of small average growth. The sandy tracts are generally wooded by Banksian pine, but in river valleys and on the heavier land poplar, birch and spruce are abundant. White and red pine are found in small groves south of Lac Seul, and are of good average size for timber. On the lake are scattered trees of both varieties. The northern limit of red pine extends to Red lake, where a few trees were observed. Cedar of inferior growth occurs in isolated localities and extends northwest to the height-of-land, but none was seen within the Berens river basin.

The timber on the banks of the upper part of Gull Rock river, vicinity of Red lake, is mostly poplar of a fair size, with a sprinkling of birch and black spruce. The birch average twelve inches in diameter, but only a few of the spruce trees were found over eighteen inches.

The forest about Red lake is somewhat varied, spruce and Banksian pine alternating as the dominant trees. On all the dry and sandy ground a thick growth of slender Banksian pine is found, and no trees of large size are apparently to be seen in such areas; but in the valleys and near the lakes black spruce is occasionally met with, forming small groves scattered through the forests of deciduous trees. Individual trees of larger size are common on the islands and points over which forest fires have not run, and such trees may attain in some instances a diameter of twenty inches, but the average is under eighteen inches. Birch and poplar are almost always present wherever the soil admits. On the richer and lower ground, between Red lake and Gull Rock lake, and farther down the river, the poplar trees are well grown and appear in groves, in which nearly all the trees average eighteen inches in diameter near the base. Farther to the westward on the higher ground, the soil being sandy, the Banksian pine is more abundant, and near the western end of Pipestone bay some trees of red pine form a small grove, which appears to be the northern limit of the species in this basin.

For the first few miles along Trout lake river, from its mouth, the trees near the river are mostly poplar, with slender spruce on the lower land just beyond.

The timber in the vicinity of Trout lake does not appear to be of importance, as the size is generally too small for commercial purposes. Banksian pine is the prevailing tree, and this generally grows in thick masses, so that the trunks are very slight. A few fair-sized spruce trees are occasionally seen and, wherever there is sufficient soil, a thick forest of small birch and poplar is found growing. Much of the low rocky country is covered by muskegs, with stunted spruce and tamarack.

The timber on the islands and surrounding hills of Bluffy lake, on the Wenasaga river, is principally black spruce, with Banksian pine showing occasionally on sandy tracts in the river valleys.

The shores of Moose lake, on the Berens river, have all been burned over long ago and are now characterized by brulé and second-growth. On other parts of this river, as far as Sandy lake, some good tamarack has been seen, occasionally twelve to four-

teen inches in diameter. Spruce is about the same size, while Banksian pine is not larger than ten inches.

The Indian reserve on Pekangikum lake, Berens river, appears fairly well timbered—principally with Banksian pine of slender growth, and some spruce. The Indians have been able, in building their houses, to obtain timber of suitable size for the walls and rafters, and spruce of a diameter of fourteen inches is fairly plentiful.

Along the Berens river, near the junction of Windfall creek, there are groves of Banksian pine and tamarac and spruce, small in size, growing in the low, swampy ground. Occasionally a small knoll is seen, with poplar and birch.

The height of land portage, on the head waters of the White river, the southern branch of the Berens river, starts in a tamarack and spruce muskeg, but eventually reaches higher ground with mixed timber, mainly hills of sandy, boulder-strewn materials. The prevailing tree is Banksian pine, and towards the end of the trail this has been thinned out by fires and wind storms, leaving a grove (at the far end) averaging ten to twelve inches in diameter.—(*Dowling.*)

Lac Seul to Cat Lake

In general the timber is rather small; in most parts of the district at present too small even for pulpwood or ties. Occasionally along streams the trees are larger, especially north of the east end of Lac Seul. Another area of good timber, chiefly black spruce and tamarack, occurs along the Root river between Lac Seul and Lake St. Joseph.

Forest fires have swept over the region, probably on the average once every 35 or 40 years. On the islands and in certain protected localities one frequently finds fairly large trees, and there is, therefore, no reason to attribute the small size of the majority of the trees wholly to adverse climatic conditions. Around Lake St. Joseph an unknown extent of forest has been fire-swept, and in many places completely destroyed within a few years. North of Slate lake, around Big Portage and Gull lakes and northward, large areas have recently been burned.

The commonest and most widespread tree is the black spruce, *Picea nigra*. Associated with this, but in very much smaller number, is the Canadian balsam, *Abies balsamea*. In the muskeg area the tamarack, *Larix Americana*, is found abundantly, rarely more than eight inches in diameter. Many of larger size are found along the Root river. The only specimens of the red pine, *Pinus resinosa*, observed were isolated trees near the east end of Lac Seul; probably there are others in the district, but no important areas are likely to occur north of Lac Seul or Lake St. Joseph. The Banksian pine, *Pinus banksiana*, however, occurs wherever the soil is suitable. The white cedar, *Thuja occidentalis*, is found occasionally along the Wenasaga river and on the Cat lake route.

A few specimens of a species of maple were noted around Lac Seul and north of it. The canoe birch, *Betula papyracea*, occurs sparingly throughout the whole region. Specimens large enough to afford bark for small canoes are found on the island in Cat lake. Associated with this birch, but more abundant, are the balsam poplar, *Populus balsamifera*, and the aspen poplar, *Populus tremuloides*. Isolated specimens of the black ash, *Fraxinus sambucifolia*, were noted in several localities, even as far north as Cat lake.—(*A. W. G. Wilson.*)

Albany River

The timber all round Lake St. Joseph has suffered greatly from forest fires at many different times from about a century ago to the present year. Parts of the main shores and many of the islands, especially in the neighborhood of the Grand Traverse, have escaped the fires, and here full-sized timber may be seen. The second growth woods are of all ages, from seedlings of a year or two up to trees nearly as large as those of the original forests. As elsewhere in these latitudes, where the old forests of spruce, tamarac, balsam, white birch, etc., have been burnt, they are succeeded by a growth of mixed aspens and white birch, with a sprinkling of spruce, or else by one consisting almost entirely of Banksian pine. In regard to relative abundance, the trees found around the lake may be mentioned in the following order: white and black spruce, tamarac, aspen, white birch, Banksian pine, rough-barked poplar, balsam, white cedar, pigeon cherry, rowan and black ash. The ground or mountain maple (*Acer spicatum*), which is interesting as an indicator of climate, is common, and it was traced for a long distance down the Albany. Of the above kinds of timber, the white spruce and the tamarac are the most important commercially. The cedar is confined chiefly to the immediate shores of the lake, where it often forms a continuous but narrow border. It has the same habit around the other lakes and along the rivers in the whole of this part of the Dominion. But it is also frequently found in large patches in the inland swamps of these regions. About twenty spruce logs, for sawing into boards, were lying at Osnaburgh House at the time of our visit. They would average eighteen or twenty inches in diameter at the butts, the largest being about two feet. The six largest showed the

following number of rings of growth:—113, 97, 121, 116, 107, and 120, or an average of 112, these rings indicating, it is supposed, a corresponding number of years. A new tamarac flagstaff, which was about to be erected, measured about eighteen inches in diameter at the butt and showed 244 rings of growth.

Wherever a view can be obtained over the country along the Albany between Lake St. Joseph and Maminiska lake, long slopes or gentle undulations may be seen, the hillsides being covered with either old timber or a second growth of aspen and white birch. Some small grey elm trees were observed at the inlet of Maminiska lake, being the first noticed since leaving Minnietakie lake, where a single small tree of this species was seen. A grove of black ash occurs with the elms, but this tree is not uncommon along the Upper Albany.

Forest fires have destroyed much of the timber along the banks of the Albany river below the junction of the Kenogami. Old spruces and tamaracs of good size are still green in some sections, but second-growth timber, much of it well grown up, prevails for the greater part of its length. A good deal of both kinds have been only recently burnt. In addition to the spruce and tamarac, balsam, aspen, rough-barked poplar and white birch occur all along. Banksian pine and ground maple were observed in the upper part. White cedar was first seen about twenty miles below The Forks. Grey elm and black ash were noted on the Kenogami just after we left the Albany or some distance farther north than they were observed when surveying this river in 1871. Groves of both these kinds of trees are found on the alluvial flats at the mouths of all the branches of the Kenogami. Cedar of good size is common all along the banks of this stream. It may be remarked that the occurrence, or otherwise, of certain trees along a river like the Albany may be due to the nature of the ground as much as to the latitude.—(*Bell.*)

Upper Parts of Winisk and Attawapiskat Rivers

Green forest of eighty years' growth surrounds the Annimwosh lakes which lie northeast of Lake St. Joseph.

Black spruce and tamarac are sparingly scattered over the muskeg areas; poplar, white birch, spruce and Banksian pine clothe the ridges. The trees are not of large size, averaging from ten to twelve inches in diameter at the stump.

Continuing up stream similar green forests are met with, and in favorable situations, such as flats extending back from bays, the trees are tall, free from branches, and have diameters of from thirteen to fifteen inches at the stump.

Around Ozhiski (Mud) lake, on the branch of the river southwest of Attawapiskat lake, and along the river, fires have destroyed much of the old forest, the ages of the trees on different areas varying from twelve to over one hundred years. Occasional trees, growing in favourable locations, reach diameters of eighteen inches, but the average is small.

Above Nibinamik lake, which lies about thirty miles northwest of Attawapiskat lake, the forest is much the same as that already referred to lower down along the Attawapiskat. Though too small for timber, excepting in limited areas, the spruce would apparently make excellent pulpwood.

The forest growth over the district generally is not large, though on limited areas the spruces reach dimensions fitting them for sawing. At Fort Hope, on Eabamet lake, Albany river, fairly clear nine-inch lumber was being sawn from trees cut near the shores. One tree was felled that gave a log over two feet thick at the butt and 100 feet long. The greater part of the forest is about eighty years old, though in places trees reaching 140 years were found. These old trees were on low-lying areas, that had escaped when the higher and dryer parts were burned, and were not generally large. Their growth-rings showed a rapid increase in size for the first fifteen years, and afterwards an extremely slow growth. The large sandy tracts are now, for the most part, covered with an open growth of Banksian pine, a tree of small commercial value. When the day comes in Canada for reforesting, these districts might be replanted with pines commercially valuable. Over large areas the spruces would apparently, if more accessible, be available for wood pulp.

Specimens of a black birch that was noted last year in this district were brought home and handed to Professor John Macoun, botanist of this department, who submitted them to Dr. C. S. Sargent for determination. Dr. Sargent has named this birch *Betula fontinalis*, Sargent, a species formerly confounded with *B. occidentalis*, Nutt. The range of this tree in the subarctic region is not yet known.

Specimens of this birch were found last year as far north as lat. 53° 35′ south of Weibikwei lake. This summer occasional trees were noted on the upper branches of the Attawapiskat river and in about the same latitude between that river and the Winisk.

The depredations of the larch saw-fly upon the tamaracs along the Winisk river were noted in last year's report. Since that time the ground covered by this insect has been extensive, and some idea of the damage they have done may be given. Last season

all trees along the Winisk river, from a point near the mouth to a point within a few miles of the Weibikwei lake, which lies about 50 miles north of Attawapiskat lake, were stripped; south of that area they were untouched. During the present spring and early summer their ravages extended southward to the Albany river and westwards for sixty miles up the Winisk river and to about midway between Eabamet lake and Lake St. Joseph, on the Albany, an area of about 14,000 square miles.—(*McInnes.*)

Boulder River

Along the Boulder river on the dry ground the timber consisted of black spruce, tamarac, balsam, aspen and white birch, but on the wet level tracts it was principally black spruce. All the rapids on Boulder river were overhung by thick groves of good sized white cedar, and the same tree was met with in groups in some of the swamps at a distance from the river. The rough-barked poplar occurs near the stream, but was seldom seen inland.

Lake Lansdowne, Upper Waters of Attawapiskat River

The shores and islands of Lake Lansdowne are well wooded with large spruce, tamarac, aspen, and rough-barked poplar, with fair-sized cedar and white birch; and the same kinds of wood continue along the banks of the river for many miles down, but the timber at a distance from the water is of smaller size. In the low, level country, not only along the lower parts of this river, but on the west side of James bay generally the greater part of the area between the rivers appears to consist of open sphagnum plains, with some small spruce and tamarac trees, either in groves or scattered singly, while the immediate banks of the streams are well wooded. In places the better class of timber forms belts extending for some miles back from the rivers.

From a point down the river about 20 miles below Lake Landsdowne to 50 miles below, the surface of the country on both sides is low and level, as indeed it has been all the way from Lake Lansdowne. Except where the timber has been destroyed by fire, there is a good growth of spruce, tamarac, balsam, poplar, and white birch along the banks of the river, but it does not extend far back, the country generally being open sphagnum swamps with small scattered tamarac and black spruce trees.

Along the upper part of this stretch (of sixty miles), on the Attawapiskat river, immediately below the lake of that name, the timber is mostly green, and some of it is of fair size, but throughout the greater part of the distance the woods have been burnt at different periods many years ago, and, whether original forest or second growth, the trees are generally of small size. In some parts, spruce and tamarac are mixed with the poplars and white birch, but in others the coniferous and deciduous trees occupy separate areas. The sections of old timber and second-growth alternate at intervals of varying length with others more or less recently burnt and not yet reforested. The white cedar is scarce, but an occasional tree is found in favorable situations much farther down the river. The last black ash observed on the Attawapiskat was passed in this section. An Indian from the Wai-nusk river, who was ascending this stretch, and who had never before been so far south, informed us that he had here seen the cedar for the first time in his life. He had not yet noticed the black ash, and had never even heard the Indian name of the tree.

Throughout the long stretch from Black Fence river, a tributary of the Attawapiskat river about 90 miles below Lake Landsdowne, to the sea, the country on both sides maintains the same level and swampy character which has been described as prevailing higher up. The timber on the borders of the river, where still green, is smaller along this section than along the upper parts. Some portions, consisting principally of spruce and tamarac, appear to belong to the original forest, but much of it is no doubt second growth, and these two species are then usually mixed with poplars and some small white birch. The growing timber, whether original or second-growth, is not often continuous for any great distance, being interrupted nearly the whole of the way by frequent sections of burnt ground.—(*Bell.*)

Winisk River

The average size of the trees growing within the country explored is not great. On exceptionally favorable tracts the spruces attain sizes quite large enough for commercial use as sawn lumber, and large areas would afford good pulpwood. Evidence of the constant recurrence of forest fires over the area is everywhere plainly seen. The brulé areas, varying from quite small patches to large tracts, are of every age; some are so old that the forest has attained the full height of the old growth, and the newer age of the trees can only be ascertained by a reference to their rings of growth, and others so recent that no vegetation covers the blackened surface. These fires are generally the result of the carelessness of Indian travellers, but may sometimes be traced to the igniting of a dry, standing tree-trunk by lightning. The oldest trees found in the whole area

were growing on a till-covered island, about fifty miles from the mouth of the Winisk river. The complete isolation from the mainland by broad channels ensured its protection from fires having their origin outside its own borders. The spruces growing here were found by their rings of growth to be between 270 and 280 years old. The diameters and ages of the trees, growing in a number of different localities throughout the region, were noted and are given in the list below:—

			Diameter in inches, 3 ft. from ground.	Age, by rings of growth.
Tamarac,	Winisk river,	32 miles from mouth.....	9	100
Black Spruce,	"	32 " "	12	125
"	"	32 " "	12	153
"	"	32 " "	8	75
"	"	50 " "	10	275
"	"	65 " near bank	8	130
"	"	65 " "	6	115
"	"	65 " 10 chains back.....	3	105
Tamarac,	"	65 " "	3	80
Black Spruce,	"	below Wapikopa lake	10	130
"	"	Wapikopa lake.....	9	145
"	"	"	6	135
"	"	Nibinamik lake.....	9	75
"	"	"	5	75
"	"	above "	15	130
Aspen Poplar,	"	" "	15	130

The rings show that the growth in generally rapid for the period between five and thirty years, and afterwards exceedingly slow.

The northern limit of a number of the common trees of northern Canada falls within the district, and of one species both the northern and southern limits.

There is a black birch that the Indians call the squirrel-bark birch. Specimens of the wood and foliage of this tree were submitted to Professor John Macoun, by whom they were forwarded to Dr. Sargent, of the Arnold Arboretum, for determination. Dr. Sargent has named this birch *Betula fontinalis*. It was not seen growing in abundance anywhere in the district, though occasional trees were noted at various points between the Albany and Winisk rivers, the most southerly occurrence being in N. lat. 51° 28′ on Dog-hole brook flowing into Lake St. Joseph, and the most northerly in N. lat. 52° 40′ on the Wapitotem river flowing into Weibikwei lake on the Winisk river. The largest tree noticed had a diameter of six inches at three feet from the ground, and a height of about thirty feet. Where seen it was growing near the banks of rivers or lakes, in moist localities. A table is subjoined of the observed northern limits of a number of species.

Northern Limits of Trees

White elm, *Ulmus americana*, Albany river .....N. lat. 51° 30′
Black ash, *Fraxinus sambucifolia*, Eabemet lake .....N. lat. 51° 50′
Mountain maple, *Acer spicatum*, between Attawapiskat and Winisk rivers .....N. lat. 52° 25′
Mountain ash, *Pyrus americana*, between Attawapiskat and Winisk rivers .....N. lat. 52° 38′
Banksian pine, *Pinus banksiana*, Weibikwei lake .....N. lat. 53°
White cedar, *Thuja occidentalis*, Weibikwei lake .....N. lat. 53° 5′
Balsam spruce, *Abies balsamea*, Winisk river .....N. lat. 54° 15′
Canoe birch, *Betula papyracea*, Winisk river .....N. lat. 54° 25′
Aspen poplar, *Populus tremuloides*, Winisk river .....N. lat. 54° 45′

The northern limits of balsam poplar, tamarac, and black and white spruce lie beyond the mouth of the Winisk river, the most northerly point examined.

Weibikwei Lake, Winisk River

Around Weibikwei lake forest fires have swept the country excepting a few places where spruces remain. Many of these are 12 inches in diameter, with trunks 30 feet clear of branches. Tamaracs and Banksian pine of good size are found in the unburnt

areas and cedars of small size fringe the shore. Going down the Winisk river, the last white cedars were seen at the north end of the lake, and the last Banksian pine about halfway down the western side, and some distance to the south of the lake the last black birch, mountain ash or rowan, and mountain maple were passed.

Near the junction of the tributaries, Asheweigkaiegen and the Atikameig, with the Winisk, the last balsam trees are seen and the last white birch ten miles farther down.

Along the Winisk, the last 25 miles from the mouth, the marine clay of the banks is capped with from 6 to 10 feet of sphagnum moss that shows little evidence of decay. Back from the banks the same moss-covered plain with scattered spruces and tamaracs extends for long distances. Sections of trees growing along the river showed very small annual growth. A black spruce 10 inches in diameter was found to have 270 rings of annual growth, and one 6 inches in diameter 110 rings. Two 12-inch trees growing on a dry knoll showed 120 and 148 rings respectively.

For 28 miles up from the sea the Winisk river has an average width of about three-quarters of a mile, increasing to over a mile in places, and is dotted with a continuous line of islands. These islands support a growth of large spruces, down to within 12 miles of the mouth. Below this, they are covered with grasses and small bushes, with only an occasional grove of large balsam poplars. On the mainland there is the same stunted forest down to within three miles of the sea. A level, sandy, treeless plain, sparcely covered with grasses and various other plants, forms a fringe along the coast.

In 1902 the tamarac trees along the river were suffering from the depredations of the larch-saw fly.—(*McInnes.*)

Kapiskau River

Along the Kapiskau river, which flows into James bay south of the Attawapiskat, a narrow ridge is well wooded where not burned over. The trees consist of large spruce, poplar, and at some distance from the coast, canoe-birch, fir, balm of Gilead, and an occasional tamarac and cedar. The tamarac here (in 1902) has escaped the ravages of the larva of the imported larch-saw fly that has done so much damage to it farther south, so that where it does occur it is green and healthy. Back from the river five or six chains the trees are much smaller, and in many places nothing is seen but muskeg thinly covered with stunted spruce and tamarac, two to eight inches in diameter, and an abundance of laurel (*Kalmia augustifolia*) and Labrador tea (*Ledum latifolium*).—(*W. J. Wilson.*)

Ekwan River, Sutton Mill Lakes

The general surface is very even on that part covered by the marine deposit, and is a gently sloping plain covered for the most part by a thin forest of black spruce and tamarac. In the river valleys, especially near the streams, other trees occur, notably the poplars (*Populus tremuloides* and *P. balsamifera*), and birch. In the case of the latter tree few large ones occur north of the Albany river, and the Hudson's Bay Company have established a canoe-building industry at Albany post to supply the Indians coming from farther north. On the Ekwan a solitary birch was seen, and that was only a small sapling on one of the islands. Five individuals of the Banksian pine were seen in one group on the north bank fifty miles up the river, so that the northern limit of both birch and Banksian pine may be said to be south of this stream. Poplars follow the valleys of the streams nearly as far north as the spruce. The country behind Cape Henrietta Maria is treeless, as is also a strip of the coast both to the south and the west of the cape.

In the southern Sutton Mill lake limestone pebbles are also numerous, but they are mixed with fragments of other rocks and are derived from the boulder-clay of the banks, while marine shells from the upper marine clay are also mixed with them. The timber seen along this lake is mostly spruce and tamarac. The heaviest growth is in the valley at the southern end of the lake and along the small streams draining into it from the west. In going up the lake the timber gradually becomes smaller, though at the portage between the two lakes there is a fair grove of spruce, and a few poplars form a fringe along the southern slope and on the lower ground south of the narrows. In the northern part there is one grove of poplar on the western side, four miles north of the narrows, growing on a ridge which seems to be made up of limestone fragments, and therefore well drained. This grove is quite park-like, it being carpeted by grass instead of the almost universal moss which seems to cover the whole country. The spruce is mainly the black species (*Picea nigra*), and scarcely any trees of the white spruce are seen. Of the poplar, both species are found on the Ekwan, but on the lake *Populus tremuloides* seems to range farthest north. Near the north end of the lake the spruce trees become not only small, but are separated from one another by mossy openings, as if they had been set out artificially. Along the top of the bank the fringe of trees is thin, and at the outlet, Trout river, a patch of burnt country will in a few years be bare. —(*Dowling.*)

Wenasaga River and Head Waters of Severn River

Spruce, poplar, Banksian pine and birch are found everywhere over the whole district. White and red pine were only noted in the southern part of Lac Seul. One solitary white pine tree occurs on Slate lake, on the Wenasaga river, and this appears to be the northern limit of the tree in this district. Ash trees were observed here also for the last time on our way north. The white cedar is a rare tree, but it occurs on the east end of Slate lake, on Sesikinaga lake, on Cedar (Kishikas) lake, and also on Greenshields lake. On the shores of the last a few rusty-looking trees are growing, and this is their northern limit. Mr. Williams, in his traverse across from Osnaburgh to Cat lake, reports seeing ash trees for the last time on the east shore of Elbow lake.

Large areas have been burnt along the route of the Wenasaga river, notably at Wenasaga lake, ten or twelve years ago, and at Big Portage lake about five years ago; also on Gull lake. North of Cat lake we enter, at the lower end of Cedar (Kishikas) lake, an area that has been burnt probably eight or nine years ago, and this extends to a few miles below the mouth of the Francis river, or a distance of over thirty-five miles. Eastward it extends at least to Windigo lake, ten or twelve miles to the right of the river, and westward as far as could be seen from the tops of the highest hills. This is generally being reforested with a second growth of Banksian pine and poplar.

In a very few places, either on the north or the south of the height-of-land, do the spruce and tamarack attain such a size as to make them economically important to the lumbering industry. On the shores and islands of Birch lake the best timber occurs; that on the branches of the Severn river is generally small.—(*Camsell.*)

Severn River, Southwestern End

The shores on Black Birch lake rise from thirty to fifty feet almost perpendicularly above the lake. Nearly seven-eighths of the timber has been burnt.

The hills surrounding Deer lake have been almost entirely burnt over by fires of different dates, and present all the different appearances of a burnt country, from the standing blackened trunks, left by recent burning, to the small second growth of poplar, and Banksian pine of earlier fires. The soil is very thin, and the timber correspondingly poor, except on a few low points where some white spruce, balsam and poplar exceed fifteen inches in diameter.

The trees around Favourable lake consist of white and black spruce, aspen and balsam poplar, white birch, balsam and tamarac, many of which exceed eighteen inches in diameter. At the end of the peninsula the foundations of several old houses were discovered, out of which trees twelve inches in diameter are growing.

Around Musk-Rat Dam lake the timber, with the exception of that growing on the points and islands, corresponds in size and variety to that described around Favourable lake. The islands, many of which are quite large, are rocky, and covered chiefly with a dense growth of black spruce.

The shore of Sandy lake is higher and more rocky than that of Musk-Rat Dam lake, but much good land and many trees of white spruce, poplar, birch and balsam were seen, exceeding eighteeen inches in diameter.

Between Sandy and Severn lakes, a distance of 114 miles by the river, there is some good soil supporting a growth of black and white spruce, tamarac, poplar and birch, slightly smaller than those seen around the lakes.[3] Approaching Severn lake the timber becomes poorer, and good trees grow only on the islands, the shore having a thick growth of black spruce, poplar and tamarac of small size. The shores and the numerous islands of Severn lake are all low and swampy, covered chiefly with black spruce and tamarac.

Along the canoe route between Severn and Trout lakes the country is for the most part swampy, with a few rocky hills almost destitute of soil, the whole covered with small trees of black spruce, Banksian pine and tamarac, few exceeding six inches in diameter two feet from the ground.

On Trout lake the prevailing trees are black spruce, with tamarac, aspen, poplar, white spruce and birch, a few being eighteen inches in diameter.

Fawn Branch of Severn River

For about sixty miles down this river from Trout lake much of the surface of the country is swamp covered with thick, wet moss, and supporting growth of small black spruce and tamarac, with a few poplar clumps. On the islands is a better growth of white and black spruce, poplar and tamarac; the last white birch was seen near the end of this course. The only timber large enough for buildings grows on islands and in the bottom of the river valley, where the soil is better and the high banks form a protection from the cold winds.—(*Low.*)

[3] The map shows two lakes, on the Severn river waters, to which the name Sandy is applied. The context shows which of these is referred to in the above paragraph

James Bay Coast, Fort Albany to Cape Henrietta Maria

Inland from high water mark is generally found a strip of low, dry mud, in places a mile wide, and covered with grass, with occasional sand and gravel bars. To the rear of this fringe of alders and juniper bushes, of from ten to sixty chains wide, reaches the spruce swamps and muskeg areas, which is the character of the ground overlying the Devonian and Silurian formations extending for 150 miles west of the James bay coast.—(*O'Sullivan.*)

Mouth of the Severn River to York Factory

From the mouth of the Severn to near Cape Tatnam no trees are seen from the shore; beyond this small black spruce come to within a mile or so of the water. The distance of the trees from the shore is due to the unfavorable soil rather than climatic influences. Between high water and the tree line the sand and gravel are almost bare, while the mud between the ridges is covered with a rich growth of grasses, affording fine feeding grounds.—(*Low.*)

5.—FISH AND GAME

The following notes on fish and game are taken from the reports of Messrs. McInnes, Dowling, Low, Bell, Camsell and O'Sullivan, and refer to sections of the country widely enough separated to represent the whole district.

Whitefish and sturgeon are the best food fishes, and occur in most of the lakes. Both are taken in nets, and the latter also by spearing from scaffolds built over rapids in the rivers. Doré and pike are also generally distributed over the whole area, and form an important source of food supply, though the sucker among the fishes, like the rabbit among the mammals, holds the most important place, as it can be caught everywhere, not only in the larger lakes but also in the smaller ponds and streams.

Brook trout were actually caught only in the Winisk river near its mouth, and in the streams running into the Albany river, but were seen in the rapids below Weibikwei; the Indians assert that they occur also in the lake itself.

Lake trout were caught in large numbers in Trout lake, at the head of the Severn river, but are not found in either the Winisk or Attawapiskat waters.

The moose (*Alces americanus*) has been found as far north as the southern shore of Weibikwei lake, in N. lat. 52° 50′, though tracks were actually seen during our exploration only as far north as the Attawapiskat river. Even here it is not nearly so plentiful as farther south in the belt of country lying near the Canadian Pacific railway, and extending for about 150 miles north of it.

Caribou (*Rangifer caribou*) range all over the district.

No red deer are found anywhere throughout the region.

The fur-bearing animals, though not so plentiful as they once were, are still fairly abundant throughout the district; the otter and the beaver, from long-continued trapping, are less numerous, perhaps, than any other species.

Bears (*Ursus americanus*) seem to be able to hold their own pretty well, and are still taken in good numbers. There is probably only one species of the common black bear, though the Indian and traders differentiate from this the brown bear, which they claim differs from the black, not only in color and size, but also in disposition and habits.

Wolves (*Canis lupus*), though scarce, are not unknown.

Foxes (*Vulpes vulgaris*), including the red, silver, black and cross varieties, are numerous, though they vary in numbers with the periodic increase and decrease in the numbers of the hares.

Lynxes (*Lynx canadensis*) are fairly plentiful.

Otters (*Lutra canadensis*) and Pine martens (*Mustela americana*) are taken in good numbers, and beavers (*Castor fiber*) occur more sparingly.

Minks (*Putorius vison*), and muskrats (*Fiber zibethicus*), are plentiful. These, with skunks (*Mephitis mephitica*), weasels (*Putorius vulgaris*), and wolverines (*Gulo luscus*), make up the number of the merchantable furs.

The rabbit (*Lepus americanus*) occurs abundantly all over the district, and is, perhaps, the most useful of all to the Indians, as it affords, during the winter particularly, both food and clothing.

That the raccoon occasionally strays as far north as N. lat. 52° is shown by the fact of one being taken by an Indian woman on the Upper Attawapiskat river in 1903.—(*McInnes.*)

Headwaters of the Severn River

Moose and caribou are fairly plentiful in the Shabumeni and Birch lake section; and bears were frequently seen on the lower parts of Cedar river. Whitefish, pike and pickerel were caught with a net in all the larger lakes; but no trout were got any-

where. Sturgeon ascend Cedar river as far up at least as the mouth of the Windigo river, and in several places the natives have gone to a great deal of trouble in building weirs across the river to catch them.—(*Camsell.*)

Trout Lake, Severn River

The water of the lake is remarkably clear, cold and deep, and is abundantly stocked with large whitefish and lake trout, which form the principal food of the Indians and Hudson's Bay Company's people living around the lake.—(*Low*).

Attawapiskat River

Sturgeon are abundant in the lakes of the Attawapiskat, and they appear to constitute the principal food of the few Indians who inhabit the country. Whitefish are also caught both in the lakes and along the river itself. Pike and suckers are abundant in all the waters. The Canada goose breeds in considerable numbers in the open swamps behind the wooded borders of the lower section of the river, and the young birds, ready to fly, were congregating in flocks, all along the lower stretch, in the end of August and the beginning of September. The dusky and other species of ducks were also numerous, and the yellow-legged plover was very abundant. We saw a few caribou and several black bears while descending the lower part of the river.—(*Bell.*)

Ekwan River and Sutton Mill Lakes

In the interior the game birds are all very scarce, the fall hunt for ducks and geese being confined to the shores of the bay. The rivers afford a limited supply of whitefish, and a small species of this fish is caught by the tide-water along the west shore of James bay. The nets are set or hung on stakes on the tide flats, and are covered by the tide for a few hours each day. Sutton Mill lakes are well supplied with a slender variety of grey trout, and the streams running to the north into Hudson bay are, at certain seasons, well stocked with brook trout. In August the stream draining Sutton Mill lake was full of these fish, and several fine specimens were caught on the lake above at the narrows.—(*Dowling.*)

Coast of James Bay, Moose Factory to Cape Henrietta Maria

Game was very plentiful; black ducks by the thousand breed in the southern part of Hannah bay, and the pintail and teal, in even greater number, breed north of the Albany. A few ptarmigan were shot near Cape Henrietta Maria and, on our return, a large number of geese were also shot.

Speckled trout and whitefish, averaging three pounds in weight, are caught in nets at the mouths of all the rivers.

At Ekwan point, while having lunch, I counted over one hundred porpoises passing close to the shore. Seals were often seen, and numerous skeletons of walruses and seals were lying on the beach north of the Albany.

Whales were not seen during the expedition, probably owing to the shallowness of the water all along the western coast of James bay.—(*O'Sullivan.*)

6.—WATER POWERS

The following paragraph is from a report, reprinted on another page, by Mr. William McInnes, of the Geological Survey of Canada. It gives a clear idea of the distribution of the drainage areas of the district. Notes, by other authors, on a few water courses follow Mr. McInnes' description. Details will be found in the reports.

The region may be roughly divided into three great areas, each with characteristic features: the Archean area of the high interior plateau; the boulder clay area; and the limestone area of the Hudson bay basin. The Archean, of the three, comprises by far the largest extent of country. It consists of an elevated, undulating plain, with an average height of from 700 to 1,000 feet above sea-level. The effects of long-continued subaerial decay and denudation, supplemented by the later cleaning up and smoothing action of a great glacier, are everywhere noticeable in the gently rounded outlines of the very moderate elevations. On it all the larger rivers of the Hudson bay watershed, and many of those flowing south and west, have their sources, the great muskeg areas acting as storage reservoirs, from which, even in the dryest season, the volume of drainage is large. It is along the parts of their courses lying within this area that the quickest descent occurs, falls and rapids that would afford water-powers being thus largely confined to the upper stretches of the streams. This condition is in contrast with that obtaining everywhere throughout eastern Canada, where the streams flow for the greater part of their length over the Archean, and only come tumbling down

from the elevations when low down in their courses, after they have attained almost their maximum volume, thus making the eastern portion of Canada probably unequalled in the world in the matter of water-powers. It must not be thought, however, that throughout the area now under consideration there is any scarcity of good water-powers. They occur in great number, but owing to the distribution of the Archean highland before referred to, they are situated mainly far inland rather than near the coast.

Albany River

In size, the Albany is comparable with the Ottawa, and at high water it might be navigated by powerful river steamers from the mouth to Martin's falls, where the first portage occurs, a distance of about 250 miles, following the general trend of the river.

From Deer Lodge lake we followed the northern and larger channel, which is broken by numerous rapids. Portages are required at four of these, the first being the Smooth Stoney portage on the north side at four miles, 715 paces long, with a fall of thirty-six feet. The others are called the three Kagami portages, and all occur in the last mile before arriving at the junction of the two channels.

The first Kagami portage, on the north side, has a fall of five feet, and is 100 paces long.

The second Kagami portage, on the south side, has a fall of 27 feet, and is 750 paces long.

The third Kagami portage, on the north side, has a fall of 18 feet, and is 570 paces long.—(*Bell.*)

Cat Lake to Lake Seul

By this route are altogether 27 portages from Cat lake to Mattawa, varying from one chain to about a mile in length. The highest single fall would not exceed 30 feet of a direct descent, but altogether the stream from its source to Lac Seul must fall from 400 to 500 feet; and as the stream is a large one, with a plentiful supply of water, it would afford any amount of force in the form of water-power, which could be utilized should the country ever become a manufacturing one.

White River, Southern Branch of Berens River

The greatest fall on this river is that at the first long portage, which is 60 feet.—(*Dowling.*)

Cedar River, Branch of the Severn

The discharges of all the larger streams were taken, and the fact established that what was considered to be the main branch of the Severn river is really not so large as the Cedar river branch. The discharge of these two streams was taken near the end of August, when the water was at its lowest stage. Cedar river was found to give 735 cubic feet per second, and the middle branch 503 cubic feet. At the junction, the middle branch is wider and deeper than the eastern branch, and it would appear to carry much more water; but there is a great difference in the relative velocities.—(*Camsell.*)

Kapiskau River

The Kapiskau river is about a quarter of a mile wide for some distance from the mouth, and has a width of from seven to ten chains at the forks. At forty miles up a section was made which showed that the volume of water at this point was 566,000 cubic feet per minute (July 4th). The width is seven chains, with an additional three chains for ordinary high water, and the greatest depth is eight feet.—(*W. J. Wilson.*)

Winisk River

The Winisk is with little doubt the largest of the rivers discharging into the west side of Hudson bay or James bay between the Severn and Albany rivers. It may be confidently stated that the total length of the river is well over 400 miles.

Its volume was estimated to be about 25,000 cubic feet per second in midsummer, at a point twenty-five miles above the bay. The volume of water in the river during the spring freshet must be quite ten times as great as at low water in midsummer.—(*McInnes.*)

7.—HARBOURS

On the Ontario shores of James and Hudson bays there are no good harbours. The general coast line is low and flat, with shallow water deepening very slowly outwards. At the time of low water, when the tide is out, along the shores of James bay only mud flats, strewn with large boulders, can be seen to seaward from high water mark. The same description applies in a general way to the Ontario shore of Hudson bay. The large rivers, the Albany, Attawapiskat, Ekwan, Trout, Winisk and Severn, together with smaller ones, flow into James and Hudson bays along the shore of the district of Patricia.

Descriptions of the harbours at the mouths of some of these rivers will be found on following pages.

REPORT ON THE

COUNTRY IN THE VICINITY OF

RED LAKE AND PART OF THE BASIN OF BERENS RIVER[4]

By D. B. Dowling

The present report contains a summary of the results of an exploration, undertaken during the summer of 1893, in the southern part of the district of Keewatin. The area comprised in the report lies just to the east of the eastern boundary of Manitoba and north of the Province of Ontario. It extends from the English river and Lac Seul northwards to Berens river, the eastern branch of which forms, approximately, the northern limit of the area. To the east, the exploration includes the heads of streams flowing eastward to Cat lake, and on the west the White river, a southern branch of Berens river, with the western end of Red lake, confine its extent in that direction.

The map which illustrates the area shows it to be situated between latitude 50° 30′ N. and 51° 50′ N., and between longitude 92° 40′ and 94° 15′ west of Greenwich, an area of 6,300 square miles.

A sketch map,[5] showing the position of this area and its principal streams and lakes, accompanies the Summary Report of the Geological Survey for 1895, in which is also a brief description of the routes followed.

All the bearings mentioned in this report are with reference to their true meridian.

PHYSICAL FEATURES

The larger part of the area forms a basin draining to the south to English river, and thence to Lake Winnipeg. In this are situated the largest lakes of the district, comprising Red lake, Trout lake, Gull Rock lake, and Shallow lake. The northern portion drains northward to Berens river and thence westward to Lake Winnipeg.

A small area containing a few lakes on the east side is found to drain to the eastward, forming a part of the Albany river basin, which empties into Hudson bay.

Southern Basin

The basin drained by the streams flowing south to English river is almost an amphitheatre in form, facing the south. The several streams converge to the convex line followed by the valley of the English river. The watershed forming the outer boundary or rim of this area rises gradually from the west toward the east, having, probably, its highest point between the waters of Cat Lake river and Lac Seul. To the west, in the vicinity of Long-legged lake, it rises to 1,200 and 1,300 feet, or sixty feet and upward above Lac Seul. North of Red lake, the portage at the height-of-land to White river is at 1,300 feet, while north of Trout lake it is considerably higher, as this lake itself stands at nearly 1,300 feet. The Woman portage, between Shaboomene and Woman lakes, is estimated to be at 1,350 feet above sea-level.

The general surface of all this basin is of a rough, rocky character, with small areas between the ridges of alluvial and glacial deposits. Across the northeastern part a strong ridge of glacial material forms a long and nearly straight line, through which two streams have cut. It is much more strongly marked near Trout lake, and there clearly forms a dam, retaining the waters of that lake. All the other lakes are evidently in rock basins, surrounded by rocky hills.

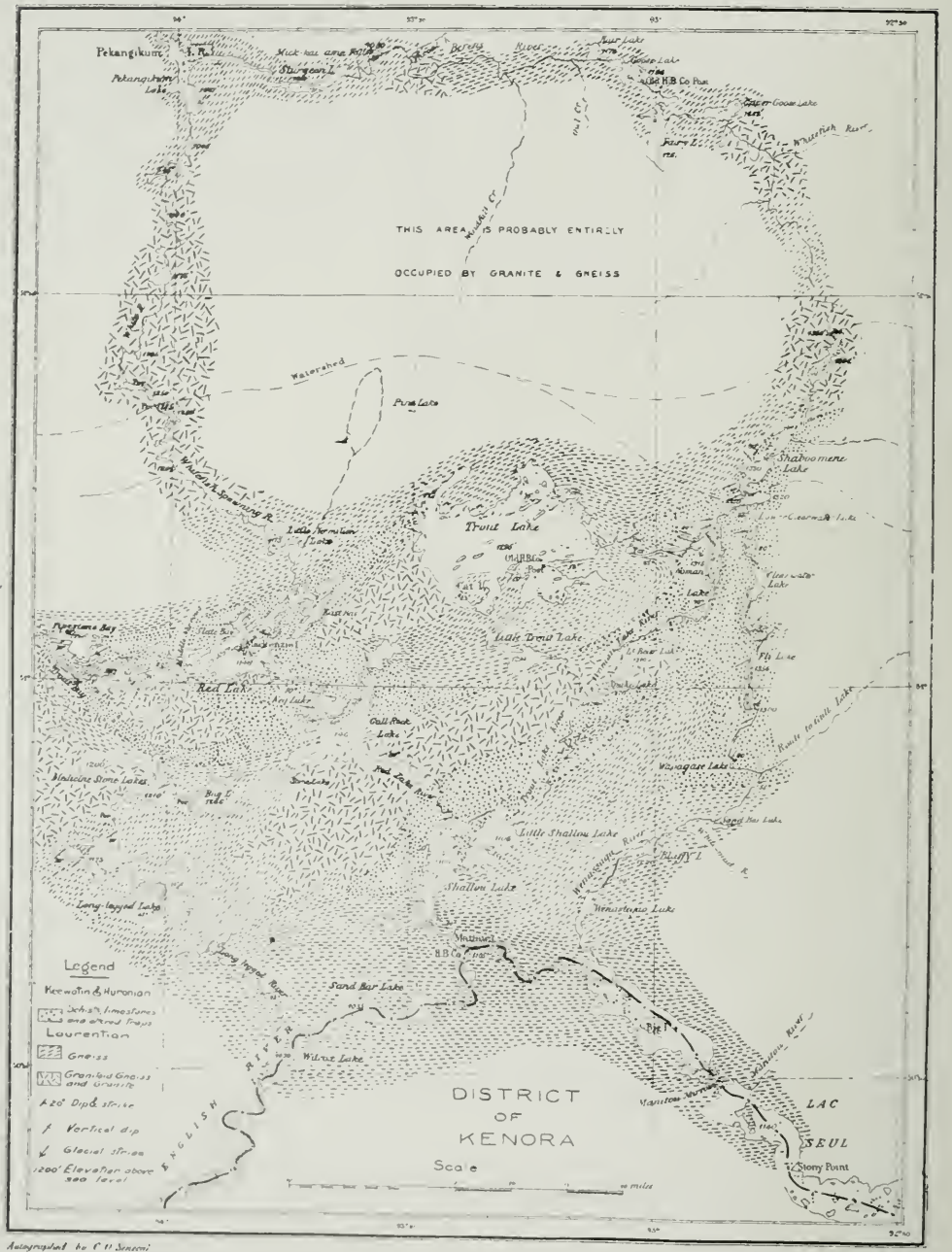
The higher parts of the rocky country forming the remainder of the basin show very little covering of drift material of any sort, except a few boulders, with sand in the valleys. North of the Trout lake ridge the most noticeable feature is the enormous number of boulders on the shore of the lake.

Effect of Geological Conditions on the Topography

In general, that part of the country in which the surface is of gneiss and schist is lumpy, with hills aligned in ridges, but the surface-level is more or less a sloping plane. In areas in which light-colored intrusive granite prevails the surface is, however, considerably raised above this plane. The Huronian areas here, as usual, show more pronounced denudation and greater irregularity in surface feature. The narrow, crooked lakes in the Woman lake region occupy gaps and gashes between high ridges. The high angle at which these rocks stand admits of a greater disintegration of the softer beds, such as limestones and chloritic schists

[4] This report forms Part F., Vol. VII., of the Geological Survey of Canada. All the bearings mentioned in this report are with reference to the true meridian.

[5] Annual Report, Geol. Surv. Can., Vol. VI. (N.S.) 1892-3, p. 22 A.



Autographed by C. H. Smyth

Accompanying Part F. Vol. VII., 1894
Geologically surveyed by D. B. Dowling

Geological sketch map of the southwest corner of the District of Patricia, with part of District of Kenora.

These areas can hardly be described as forming basins. The general surface of the country is apparently higher than elsewhere, but it contains deeper depressions, which are occupied by lakes. In tracing out the line of contact of the granite with the green Huronian schists of Red lake, it is found that nearly half the area of the lake is underlain by granite, so that this lake is not properly described as a basin in the Huronian rocks, though the greater part of its northern arms and bays are entirely within that area.

It will be noticed on reference to the map that, although the Huronian areas are evidently well sprinkled with lakes, still the largest basin of all, Trout lake, is altogether beyond them and is most probably not a rock basin at all, the southern side being a dam of morainic material. The suggestion that this is the case arises from the fact that not only are there but one or two low rock-exposures along the northern foot of this ridge, but that the lake lying only three or four miles to the south of Trout lake, over this ridge, is estimated to be about one hundred and fifty feet below, and is fed by two small streams having their origin in the hills between, and carrying relatively more water than the small area they are supposed to drain would naturally produce.

Relative Heights of Lakes

In order to obtain a relative scale of heights for the lakes and hills in the district an estimate of all the various falls in the rivers and on portages was carried from the railway through to Berens river by both routes followed. The aneroid barometer was used on long portages and in measuring the height of hills.

The estimated heights above sea-level of the principal lakes in this area, obtained in the above manner, are as follows:

	Feet.
Lac Seul	1,140
English river at Mattawa	1,105
Shallow lake	1,105
Little Shallow lake	1,106
Sand Bar lake, English river	1,035
Wilcox lake, English river	1,030
Long-legged lake (Lower)	1,173
Long-legged lake (Upper)	1,175
Gull Rock lake	1,146
Red lake	1,148
Little Red lake, or Little Vermilion lake	1,173
Lake at height of land north of Red lake	1,250
Bug lake, south of Red lake	1,266
Upper Medicine Stone lake	1,210
Lower Medicine Stone lake	1,200
Trout lake	1,295
Snake lake	1,270
Little Bear lake	1,310
Woman lake	1,315
Fly lake	1,356
Bluffy lake	1,220
Sha-boom-ene lake, draining to Cat river	1,330
Head of eastern branch Berens river	1,350

Long-Legged Lake and River [5a]

A small stream enters the western end of Wilcox lake, draining a series of closely connected lakes known collectively as Long-legged lake. The lower part of the stream flows through low swampy country gradually rising to the west. The channel is wide and deep, with sluggish current, and the course is crooked, but with long bends. This character continues for five miles, where a fall of eighteen feet over a ledge of dark gneiss is reached. At the time of our visit (August 30) very little water was running, forming a thin veil the whole width of the ledge, but in high water it must be a fine fall. A portage of one hundred yards is on the east side.

The stream above the fall continues of about the same character, but flows through a sandy country with few rock exposures. The timber is mostly Banksian pine of small size. Between the falls and short rapids there is a very light current, so that it is easily navigated, except that in the upper part, near the lake, there are numerous short portages which take time to surmount. Two miles beyond the eighteen-foot fall

5a. The routes here described are shown on maps on following pages of this volume. W. G. M.

is another of twenty feet, with a portage of seventy yards; this is followed in a quarter of a mile by a fall of thirty feet, with a portage of one hundred yards.

From a short distance below this fall to near a small lake expansion two miles above, the borders of the river are fringed with rushes and wild rice, with sandy country behind covered by a close growth of slender Banksian pine. Occasionally, on lower ground, small patches of spruce and tamarack occur, in which are seen a few trees over eighteen inches in diameter.

The small lake which the river passes through has originally been a basin of two miles in length and a quarter of a mile in width, lying in a trough between gneiss ridges running east and west. The river-valley enters this basin on the middle of the northern side, and flows out at the eastern end. The sediment brought down and deposited by the river has formed a delta, by which the lake has been divided into two parts, separated by a low, marshy flat through which the river now winds in a very irregular course. The older part of the delta is higher ground and produces fine wild hay, while the immediate banks of the stream are lined by rows of ash and elm, as commonly found in Manitoba.

Above this lake the river bears north-westward, through level country, and in a mile turns westward, winding in the bottom of a low flat valley or depression between higher ridges and knobs of gneiss. The stream passes near a high steep rock of gray gneiss, in vertical beds, running to the west. The banks are clay, and on the north side of the valley, half a mile east of the steep rock, the stream has cut into a hill which shows sixty feet of stratified clay.

The river now becomes irregular in its course to the outlet of the lake, descending in a distance of two miles over several ledges of gneiss, in falls and rapids, successively of 1 foot, 5 feet, 3 feet, 30 feet, and 3 feet, or aggregating seventy-two feet, at all of which short portages are necessary in low water, and in high water at five of them.

The lakes, forming a group at the head of this stream, are all of irregular shape, but generally lie northeast and southwest, or across the general direction of the drainage, following somewhat the strike of the rocks. Long bays run in the same direction on either side of the lakes. The ridges or hills of the surrounding country also mainly run with the strike of the gneiss.

The first lake of the series is four miles long and one and a half wide. Two large islands are found in the northern half. A long narrows, of nearly two miles, connects this with the second, which is of the same length in a northeast and southwest direction, but a mile wider, having few islands in the central portion but a number scattered along the shores. A crooked narrow lake, running from the western side towards the north, and then turning west, brings us to the north end of a small lake terminating at the south end in three long finger-like bays. On the northwestern side, at an opening leading to a small lake, we find a swift current, with a fall of a foot over gneiss rock. Here the Indians have constructed a fishing weir or dam, to which they resort in the autumn. After crossing a small bay or lake expansion, half a mile in diameter, a narrow opening admits to the upper or most western lake of this series.

This is the largest of the Long-legged lakes, but still is of no very great extent. It might be called a rectangle in shape, with one diagonal running east and west, and having sides of three miles each. The river leaves by the eastern end, just north of which runs a narrow arm of a mile and a half in length to the northeast. At the south end a short bay breaks the regularity of the shore, but at the west end there are two bays, the one forming a small lake with a narrow entrance. This bay is a mile in diameter, while the one on the north is smaller and likewise nearly cut off from the main lake. The islands are mostly narrow ridges of gneiss running northeast and southwest. The hills surrounding this western lake are much higher than to the east, and it appears to be at the extreme western limit of the watershed. A stream enters the west bay, but it is a very small one fed by two or three large muskegs and small lakes lying immediately behind the first ridge, west of which again higher ridges are seen.

We climbed several hills to the west of these two bays and found them to be principally composed of horizontal beds of gneiss, broken and fissured by large dykes of pinkish granite. The most western hill was almost entirely granite, sending out wide dykes of pinkish colored granites through the broken gneiss to the eastward.

Mattawa River

The largest stream joining the English river on the north side, below Lac Seul, is the Mattawa. This enters at what was formerly an Indian reserve, but where there is now only a Hudson's Bay Company's trading post, called Mattawa. The river to which the name applies is but a short strip of sluggish water connecting the English river and Shallow lake. Above this there are two streams whose waters discharge by the Mattawa. The Trout Lake river empties into Little Shallow lake lying to the east, and thence flows to the northeast corner of Shallow lake. At the extreme northern end of

this lake is found the mouth of Red Lake river. These two are both fair sized streams, so that the flow of water in the Mattawa is considerable, but, owing to the large size of the channel, the current is very slight. From the river to the lake, a distance of four miles and a half, this strip of water occupies a wide valley enlarged into lake-like expansions, which apparently often serves as an overflow channel from the English river, at times of high water. As an example, during the summer of 1893, between June 30th and July 17th, the waters in the Shallow lakes and English river at Mattawa rose six feet; this rise was not occasioned by increased flow in the Trout Lake and Red Lake rivers, but altogether to the increase of volume in the English river, showing that the formation of the large channel of the Mattawa has been aided by the ebb and flow from freshets on the English river.

This channel is cut through soft stratified beds of sand and clay which occupy the lower country between the hills. The English river, below the junction, is held back by a rocky barrier of gneiss, which, striking to the west, forms ridges running generally in that direction.

Shallow Lake

Shallow lake is a long narrow strip of water, ten miles in length, lying north-and-south. From the south-western angle, a narrow arm runs westward about two miles, widening out and terminating in a round bay containing two small islands. In the main body of the lake a number of islands are scattered in irregular order, numbering in the aggregate about thirty.

The shores of the eastern side are in general of easy slope, the country behind rising gradually to the high land lying north of English river. The narrow strip separating the two Shallow lakes is generally low, but rises in a high narrow ridge to the north, which, with a similar one lying to the west, but starting from the north end of Shallow lake, forms a valley. Through this the waters draining into the smaller lake reach Shallow lake in a wide sluggish stream, bordered for the most part by grassy and rush-grown flats, with a fringe of small willow bushes.

The same gap or valley continues to the north-east, and down it a small stream flows. A continuation of the eastern ridge, which forms a prominent point just west of the mouth of Trout Lake river, parallels the course of that stream for some distance.

The low-lying country on the east and south-east of these two lakes is found to be underlain by gray gneiss, while the change to steeper slopes and higher hills running parallel to the shores of the south and west is principally due to the change in the character of the rocks. Those on the west are mainly a series of fine-grained dark gneisses.

Lying across the mouth of the valley of Red Lake river are two prominent hills, which on examination were found to be morainic, or of glacial origin. These are very noticeable, and are seen for a long distance down the lake.

Red Lake River

This stream empties into a bay at the north end of Shallow lake. A short rapid or fall, of a foot or more, is found at its mouth, caused by a ledge of dark, fine-grained, rusty, green slate or schist. In high water in the lake this rapid is drowned out.

Above this the river makes a long bend to the west, to the north of the prominent hills just mentioned. The hills take the form of narrow ridges, of no great length, lying west-south-west, and east-north-east, with an altitude of one hundred and seventy feet above Shallow lake. The slopes are thickly wooded with small Banksian pine and spruce. The sides of the hill show no rock in place, but everywhere pebbles and boulders of loose rock are seen. The material of the hill is apparently a mass of fairly well rounded pebbles and boulders, with sand and gravel filling the interstices. On the southern slope large blocks and angular boulders are occasionally seen on the surface. Most of this material is of grayish gneiss and granite, with a few scattered pieces of the green felsites and schists of the Huronian.

Northward, the river passes through a low strip of country gradually rising, and at a mile and a half the banks are twenty to thirty feet above the water. Here the first heavy fall occurs, caused by a band of dark schists. The portage past this leads up a steep bank of clay and sand on the west side to thirty feet above the river, and along a level terrace, descending with a more easy slope to the river above. The distance is 250 yards, and the fall in the river fifteen feet.

At about half a mile above this, there is another small fall of ten feet. Although rock in place is seen at the foot of the fall, the obstruction seems to be occasioned by a great accumulation of boulders, and in the river, just above, large angular boulders of granite nearly fill the channel. Their presence is accounted for by the fact that the river here cuts through a ridge of morainic material, which is seen to be a spur from a high ridge running off to the north-east. The portage is on the east side, and is one hundred yards long.

Farther up the stream is wide and has little current to the next fall, the general course being to the north-west, but including a long curve to the south. Here an accumulation of boulders in the bed of the stream causes a rapid with a fall of twelve feet, to pass which there is a portage road of 170 yards on the west side.

The upper part of the river to Gull Rock lake is a succession of small lake-stretches, with a wide river-channel connecting them, in which the current is appreciable in one place only, where there is a hollow bar.

The timber on the banks is mostly poplar of a fair size, with a sprinkling of birch and black spruce. The birch average twelve inches in diameter, but only a few of the spruce trees were found over eighteen inches.

Just to the east of Gull Rock lake a small lake-expansion of less than two miles in diameter is crossed. On this a light granite with slight foliation is seen, and the same rock is probably to be found on the river below, though no exposures were met with.

Gull Rock Lake

This lake, which lies immediately to the east of Red lake, with its longest diameter north-and-south, has a total length of eight miles. The inlet and outlet are on the south-west and south-east sides respectively. The northern part is narrow, but towards the south the lake widens out to four miles. A string of islands runs across south of the middle, and others are scattered along the eastern and southern shores. To the south the shores are high and bold, but to the north more gradual slopes prevail, while on the western side one bold hill of granite is conspicuous. A small creek at the north end leads to another lake of three miles in extent, occupying the same trough, beyond which is a high ridge separating these waters from Trout lake.

A deep channel joins Gull Rock lake with the western end of a small lake called Keg lake, lying to the north-west, and a short portage connects the two, saving about three miles of travel by the river.

Red Lake

About three miles west of Keg lake by the river is the entrance to Red lake. No idea of its size or shape can be formed on inspection, as from the great number of islands and the irregular shape of its shores no great view of any extent of water is seen, and it is only by traversing the whole of its shores that its area can be appreciated. The largest open part is that which is entered first. From this to the west extends a long narrow arm, which contracts in several places to less than a quarter of a mile. At the western end a narrow, crooked channel connects with what is called Pipestone bay, a small expansion of two miles in diameter, where the Indians obtain stone for making pipes. This is a soft compact chlorite, and the pieces they use are from loose boulders, though the rock was seen in place in a thin band in the narrows.

An arm or long bay runs to the north-east from the main body of the lake, and connects by a narrows with a long lake lying about parallel to its course, on the east, joining it at about two miles from its northern end. This addition is about six miles long and less than a mile wide, and lies in a trough in the Huronian, the shores following in the main the strike of the rocks.

The total distance from the extreme north-eastern end of this bay to the western end of Pipestone bay is twenty-seven miles in a west-south-west direction. At right angles to this, the greatest breadth, which is from the outlet northward to the end of a bay on the north side, is roughly seven miles.

The forest about this lake is somewhat varied, spruce and Banksian pine alternating as the dominant trees. On all the dry and sandy ground a thick growth of slender Banksian pine is found, and no trees of large size are apparently to be seen in such areas; but in the valleys and near the lakes black spruce is occasionally met with, forming small groves scattered through the forests of deciduous trees. Individual trees of larger size are common on the islands and points over which forest fires have not run, and such trees may attain in some instances a diameter of twenty inches, but the average is under eighteen inches. Birch and poplar are almost always present wherever the soil admits. On the richer and lower ground, between Red lake and Gull Rock lake, and farther down the river, the poplar trees are well grown, and appear in groves in which nearly all the trees average eighteen inches in diameter near the base. Farther to the westward on the higher ground, the soil being sandy, the Banksian pine is more abundant, and near the western end of Pipestone bay some trees of red pine form a small grove, which appears to be the northern limit of the species in this basin.

Streams Flowing to the Red Lake Basin

The streams flowing from the south to Gull Rock lake and Red lake are all rather small. The first one examined was a small stream draining Stone lake, and emptying into the south bay of Gull Rock lake. This proved to be very shallow, and the lake is

of small size, lying between hills of granite, with occasionally fragments of Huronian rock caught up in it, showing at a few points on the lake.

Another lake lying farther to the west, called Bug lake, drains by a small creek to the western extremity of the south bay of Gull Rock lake. The valley in which this lake and stream lie runs west by south-west from Gull Rock lake, following the strike of the gneisses and altered rocks. The distance from lake to lake by the river is about four miles, with two miles of the western part over a lake connected with Bug lake by a short reach of sluggish river. The upper part of the stream is very shallow and is overhung by tall gray willow bushes, making travelling along it difficult. Two portages were made past rapids. The fall at the lower one is seventy feet and at the next forty feet, so that the lake lies at an elevation of about one hundred and twenty feet above Gull Rock lake.

From a bay on the south-west a portage leads to a small lake draining to Red lake. The road is through scrub pine brush with mossy floor, over a slight rise for about 600 yards—the terminal points being at about the same elevation.

The stream which rises here flows through several large lakes, and reaches Red lake about a mile east of a narrows near the middle of the lake (Middle Narrows). The small lake at the head waters is bordered by mossy muskeg, and is about one-third of a mile in length. The stream flowing from its western end is too small for canoes, and the portage to the next lake is through spruce bush for 1,000 yards. The fall is about fifty feet to a lake less than half a mile in length. Two small portages and an intervening pond lie between this and the Upper Medicine Stone lake, which is a long narrow strip of water running to the south-west. Its total length is six miles, with a breadth averaging half a mile. The north-west shore is bold and is of granite, while the south-east is lower and shows fewer exposures, principally altered rocks and dark-green eruptives, with granite in a few places. Between the points the shores are mostly of angular boulders.

The gneisses of the southern part of the lake run in about the average direction of the length of the lake. The stream enters at the eastern end and the outlet is from a bay on the north shore, about two miles to the west.

From the south-western end there is a portage of a mile to the south, to a small lake draining to the upper part of Long-legged lake.

Lower Medicine Stone Lake

A short stream connects the two Medicine lakes falling into the eastern end of the lower. This is somewhat similar in character to the former, in that it is a long narrow lake, but it runs more towards the west. It is about the same length, but broadens out to nearly a mile at the western end. On the southern shore, which is low, is to be found only drift material, but the north side is bold, with hills of gneiss running to the west and rising steeply.

At its outlet, at the eastern end, on a low point surrounded by trees, is a tall boulder of gneiss, left standing on edge by the ice. The dimensions of this stone are: height above surface, fifteen feet; length, fifteen feet; breadth or thickness near the top, eight feet, narrowing near the ground to five. This stone was of course an object of wonder to the Indians, and offerings of tobacco, pipes, and other valuables have been made at its base for years. This lake has evidently derived its name from this "medicine stone."

The elevation of the upper lake is about sixty feet above Red lake, that of the lower one about fifty feet, and that of a long crooked lake below, near Red lake, about fifteen feet.

The stream leaves Lower Medicine Stone lake near the eastern end, and in half a mile reaches a small pond, on an island in which is found an exposure of light green porcellaneous rock, which is similar to some in the Huronian area. The band must be narrow, as on the next small lake to the north granite is seen, and this continues to near Red lake. The long crooked lake lying near Red lake is in a basin in the granite, and the fall at the outlet is across the contact with the Huronian.

In the angle formed between the two streams just described are several small lakes, which drain to the river between Keg lake and Gull Rock lake, but they were not examined. At the extreme west end of Red lake a small stream falls with heavy rapids into the long arm or bay south of Pipestone bay, called Trout bay. This drains a long crooked lake of clear water about seventy feet above and seven hundred yards south of the above arm, and, like the one to the east, lies in an area of granite, the river, as in the former case, falling in rapids from the contact line. The upward extension of this stream, which flows through several small lakes, passes through an area of apparently altered Huronian which has been split off from the Red lake band. The upper lake reached is altogether surrounded by granite.

The streams entering the northern side of Red lake are all of small size, with the exception of one near the north-east corner. This was ascended to near its source,

where there is a portage to the headwaters of the southern branch of Berens river. Atick-o-meg wam-en-e-kan Sepi (whitefish-spawn river) is the Indian name for this stream, and it is much the largest entering Red lake. A short distance above its mouth rapids commence, and between Red lake and Little Vermilion lake there are four portages in a distance of less than two miles. These are all short, and at falls, in ascending order, of eight, six, six and three feet, respectively.

Little Vermilion lake, is about four miles in length, in a north-west direction, and is divided into two parts by a narrows. The western part is much the larger and contains many islands. Two small streams drain to this lake. The smaller enters at the north-east corner of the lower part, rising to the north-east in a large lake named Pine lake, while the other rises in several small crooked lakes lying to the north-west and empties into the north-west corner. Pine lake was not seen, but the Indians describe it as a fair-sized lake, having very few rock-exposures on its shores, with a surrounding country very sandy in its nature and clothed with scrub pine. The stream entering Little Vermilion lake on the north-west forms part of the through route northward to Berens river. For a couple of miles west it is wide and deep to a small lake divided by a narrow passage in the middle, the western part containing a number of islands. Above this the river is very crooked, and in its upper part it falls in a number of rapids, at which there are short portages. Gradually the hills approach the river, sandy ridges covered with scrub pine being succeeded by hills of granite. The stream is then a series of dead water stretches, separated by short falls. The average course up to the lakes at the height-of-land is north-west, and the distance from Little Vermilion lake to the portage at the height-of-land is about fifteen miles. The estimated fall from its source to Red lake is 100 feet.

The trail leading to White river, the southern branch of Berens river, is one mile in length, crossing ridges of granite and gneiss, fairly well covered by spruce and poplar. By readings of the aneroid barometer, the lakes on either side are at about the same elevation, while the ridge rises thirty or forty feet higher.

Trout Lake River

To the east of the high point, on the north side of Little Shallow lake, lies the mouth of this river in a low marshy bay. To the north-east, for seven miles, the country is low, so that the river runs with wide channel in a fairly straight course. The banks are from four to eight feet, rising gradually from the lake, where they are very low. The trees near the river are mostly poplar, with slender spruce on the lower land just behind. Occasionally Banksian pine is seen on the dryer parts. The first fall met with is over an accumulation of boulders, derived from a ridge of sand and boulders through which the river has evidently cut its way. At the foot of the fall the Indians form large camps in the autumn to catch whitefish as they are ascending the river to the spawning grounds. The banks immediately above are of sand, with boulders at the bottom. These are found of all sizes and colors, the largest being of dark green rock, probably transported but a short distance. The obstruction formed by these boulders, there being no rocks seen in place, causes a fall of ten feet.

For two miles and a half above the first fall the country seems low, and the river runs in a fairly even course from the north-east, but at this distance a heavy series of falls is encountered. Near this are exposed in the banks dark-green rocks, which at the fall are cut by light reddish granite. These are crossed by the river above, and evidently cause the fall, which is estimated at sixty feet, and a portage of four hundred yards is made on the north-west side. Above this a short distance is another series of short rapids round a long bend, amounting to a fall of ten feet. A portage of two hundred and fifty yards is made across the bend. A quarter of a mile north-west is the Manitou fall, where the channel contracts, and the water pours over a band of fine-grained gneiss, making a perpendicular fall of fifteen feet.

The direction of the river between these last two large falls is nearly at right-angles to its general course, and in this distance it appears to cross a wide band or area of intrusive granite. Above the Manitou fall, after a few irregular bends, it regains its former course. Cat fall, the next above, is a narrow chute between dark-green hornblende rock of eruptive origin. The descent is about four feet, and a portage is seldom made. Above this the river broadens and the current is sluggish. Two miles up the stream divides, the western branch coming from Trout lake, the eastern from Woman lake.

The stream from Trout lake leaves it by a bay at the south side, passing by a long narrow lake-expansion to the south-west, and turning east runs through Little Trout lake, following a course parallel to the strike of the gneisses. The outlet from this lake is at the east end, where the river follows a gradually narrowing channel, ending in a heavy rapid. Below, it becomes irregular, making a course of about three miles to reach a point two miles south-east. In this distance the river falls eighty

feet and four portages are made, all rather short, the longest being about 300 yards. At the lowest one the trail runs over a ridge rising thirty feet above the river at the upper end, and by exposures on the trail the hill seemed to be principally of boulder-clay. Between this point and the junction with Woman Lake river the course is directly south, but with many minor bends and little falls through a swampy tract, in which hills of granite appear.

Woman Lake River

The stream joining Trout Lake river from the north-east is of about the same volume as that from Trout lake. Just above the junction, it comes rushing through a narrow rocky gorge in the granite and gneiss, falling fifty feet, past which there is a portage-road of half a mile in length. A quarter of a mile above, a small fall of fifteen feet is passed by a portage of 160 yards, when we reach Snake lake, the first of a series connected by short river-stretches, ending with Fly lake, which lies east of Woman lake, near the head-waters of the stream. The second in the chain is Little Bear lake, about thirty-five feet above Snake lake, the ascent being distributed among six small falls, in a stretch of a mile in length. A narrow and crooked lake, six miles in length, succeeds the expansion called Little Bear lake, and by a reach of river a mile in length is connected with the southern end of Woman lake.

Woman Lake

A long narrow lake expansion extends to the north-east for seven miles. Turning north, the lake widens to much larger dimensions, having an average width of a mile, for five miles of its course. This part is thickly dotted with islands, while the shores are bold, rising in high hills behind. The total length is about fourteen miles. At the northern end a small stream leads to a couple of lakes lying to the north-east. This is the most northerly point of the Woman lake basin, as a portage of a mile from the upper lake brings us to the waters flowing north-east to Cat Lake river and ultimately to James bay.

Three lakes to the south, lying east of Woman lake, drain directly north to this point. The first two are called Clearwater lakes, and the last Fly lake. They are long, narrow strips of water, with many islands, and are similar in character and surroundings to Woman lake. The fall from Fly lake, the head-waters of this branch, to Woman lake, is estimated at forty-two feet, or from Fly lake to the English river, at Mattawa, 451 feet.

It is found on passing through these lakes that they occupy a trough or troughs in dark Huronian rocks. Their narrow basins closely follow the strike of the beds.

Trout Lake

The position of this lake is to the north-east of Red and Gull Rock lakes, but a few miles from them. Its extreme length is sixteen miles and its breadth thirteen, with an average width of eight miles. Its greatest diameter lies about east-north-east, or almost parallel to that of Red lake, and nearly in the same general line. It is not, however, of the same broken and irregular character. Numerous islands are scattered through it, but in the central portion is a large open sheet of water. On the northern side are two large bays, the western one being a long narrow arm, stretching to the north-east, with a group of islands at its mouth. At the northern corner another large bay is found, almost filled with islands, and across its mouth a string of long islands extend from the eastern shore. The river leaves the lake at the south-west corner of a large bay on the south side. Eastward, another arm stretches for three or four miles, leaving a long peninsula, on the extreme end of which, in former times, the Hudson's Bay Company maintained a trading establishment.

The south-western shore is regular and is determined by a long ridge of morainic material, chiefly sand and boulders, which extends in a continuous line from the western extremity of the lake south-eastward, bordering the south-western shore of Little Trout lake, and apparently running in the same direction till it crosses the river at the lowest rapid. The height of this ridge just oposite Cat island on Trout lake was found by aneroid readings to be 270 feet above the lake.

Cat island, the only large island in the lake, rises in a high dome-shaped hill about 200 feet and seems to be covered with sand. The shores, especially of the southern part of the lake, differ materially from those of all the other lakes in the district, in that they are almost everywhere piled high with boulders. The peninsula lying between Cat island and the outlet is covered mainly with sand and gravel. The site of the Trout lake trading establishment is at the outlet, on a high ridge of this material about thirty feet above the lake. Good soil seems to have been found there for gardens on a small

space near the foot of the slope. The place is now practically abandoned, except in the winter.

The streams entering Trout lake appear to be rather small. A little creek enters the bay at the western end, but a larger one entering at the extreme north of the lake is sometimes used by the Indians as a means of getting to Pine lake. The river is small and only light canoes are used. At the east side a small stream is ascended, and a long portage made to a long lake draining eastward to Woman lake.

The timber in the vicinity does not appear to be of importance, as the size is generally too small for commercial purposes. Banksian pine is the prevailing tree, and this generally grows in thick masses, so that the trunks are very slight. On the ridge to the south the undergrowth is of this scrub pine, and so close that it is difficult to find a way through. A few fair sized spruce trees are occasionally seen, and on the portages on the river below, wherever there is sufficient soil, a thick forest of small birch and poplar is found growing. Much of the low rocky country is covered by muskegs, with stunted spruce and tamarack.

The elevation of Trout lake is estimated as 1,295 feet above the sea, or one hundred and ninety feet above Shallow lake, and eighty feet above the forks of the river.

Wenassaga River

The streams flowing south to Lac Seul are none of them as large as Trout lake river. At the Manitoba narrows, a small stream enters from the north, called Manitou or Manitoba river. This was not explored, but is reported to be navigable for a short distance only.

At a mile from the western end of the lake a larger stream is found. This rises to the north-east, near the head-waters of a branch of Cat Lake river, and by means of a portage made from one to the other a short route to Rat Portage [5b] is formed. The lower part and the western branch were traversed in our trip through from Trout lake via Woman lake and Fly lake. The eastern branch was not explored, but a few notes on it are given by Mr. Fawcett in his report to the Surveyor General, from which the following extracts are taken:[6]

"Having heard of a canoe route from Cat lake to Lac Seul, which could be travelled in a short time, I determined to return that way at once, and started amid a violent snowstorm and before a driving wind, against which, had it been in our faces, we could not have made any headway. We retraced our route until Gull lake was reached, and following a channel for about two miles, which enters the lake on the west side, we came to another large lake, also called Gull lake, as it forms part of the same body of water, and it is about the same size as that part of the lake crossed by the traverse line, or about five miles in diameter. The shores of that part crossed by the line are pretty regular, but the westerly shores are deeply indented with large bays and offshoots from the lake. Ascending a small creek from Gull lake for about six miles, we reached the height-of-land portage, the first part of which was about three-quarters of a mile in length, and muskeg most of the way. We then came to a small lake which was frozen over, and were delayed for a time breaking a channel through the ice. After crossing two small lakes and three portages we reached a small stream, which, after a day's travel, attained the dimensions of a fair sized river, called by the Indians Wenassaga Measibi, which we followed to Lac Seul. By this route there are altogether twenty-seven portages from Cat lake to Mattawa, varying from one chain to about a mile in length. The highest single fall would not exceed thirty feet of a direct descent, but altogether the stream from its source to Lac Seul must fall from 400 to 500 feet; and as the stream is a large one, with a plentiful supply of water, it would afford any amount of force in the form of water-power, which could be utilized should the country ever become a manufacturing one. In a few places I noticed soil of vegetable mould and clay loam, which would be well suited for the growth of grain and vegetables should the climatic conditions be favourable. I also observed here that the best soil generally produced a growth of poplar, and wherever it appeared large and thrifty good soil might be looked for, comparatively free from rock. On the rocky ridges, as usual, scrubby pine was the prevailing timber, while the flats and muskegs were invariably covered with spruce and tamarack. The good land noticed seemed to be in belts three or four miles wide and extending north and south for a considerable distance, as might be expected from the geological formation, the depressions and elevations succeed each other in very regular order and much in the same direction. In places the spruce and tamarack would attain a growth of two feet in diameter and a good height, but this was not the rule—ten or twelve inches was about the average."

In its lower part this stream passes through two moderate sized lakes. The first, Wen-áste-ga-o lake, is situated at a couple of miles from Lac Seul, at an elevation of

[5b] Rat Portage is now called Kenora.

[6] Annual Report of the Department of the Interior, 1885, part II., p. 37.

sixteen feet above it. This fall in the river occasions three rapids, the first of which has a fall of six feet and is a mile from the mouth. A small rapid just above is next tracked up, above which to near the outlet of the lake the river is deep and easily navigated. Just at the outlet, a band of micaceous gneiss forms a barrier and the river falls three or four feet. A short portage on the west bank leads to the lake, which is three miles long and one broad. On the west side runs a high ridge of hills, of granite and gneiss. On the east the hills are lower, and the exposures of rock form flat glaciated surfaces, while in one locality the waters of the lake have worn into a bank of sand, laying bare fifteen feet of stratified beds. For some little distance up this river and past the next lake a small stratified deposit of sand fills the narrow valleys and depressions between rocky knolls. In the river above, the course of the stream is between ridges of gneiss running south-west. The river breaks through from one ridge to another, but the older valleys between these ridges appear to be filled in with the sand deposit.

Bluffy Lake and White-mud River

The two lakes through which the river runs are of much the same character, except that the upper one, Bluffy lake (Kah-mini-ta-gwa-qui-ack Sakahegan), is dotted with several islands, and one, a mile in length, divides it into two portions. The difference in level between these lakes is about sixty feet, which is found at two heavy falls near the outlet of the upper one. The first or lower rapid has a fall of nearly forty feet; then, at the outlet, is another of twenty feet over a ledge of mica schist. On the portage at the lower fall the rocks are very much twisted and broken into by dykes of reddish granites. At the upper one, less disturbance was noticed, while on the lake the beds are not contorted, but show considerable squeezing.

The total length of Bluffy lake is four miles and a halt, with a width of one mile. The timber on the islands and surrounding hills is principally black spruce, with Banksian pine showing occasionally on sandy tracts in the river-valleys. At the upper end of the lake a stream from the east enters by a wide mouth. The volume of water coming in is not great, as the channel soon contracts to a small stream with muddy water, evidently draining from a valley with soft clayey deposits. This stream was not explored, but with small light canoes it might be ascended for some distance. It is called White-mud river (Wab-an-unkie-Sepi).

The main stream for two or three miles above flows in a wide channel through a low country, with the borders of the stream rush-covered, and in many places wild rice is found growing thickly. A band of mica-schist crosses a bend in the river, causing falls of three or four feet at two places, between which is a small lake or pond. To the east, and connected by a narrow opening, lies a lake of over a mile in length, at the eastern end of which the Sand-bar river enters. This is said to drain several lakes lying farther to the east.

To the south are some sharp hills that have the appearance of being of the same nature as the ridge of gravel and sand seen at the north end of Shallow lake.

From the pond above mentioned to the forks, a distance of five miles, there are four small falls, one with a fall of three feet; two about half way, aggregating five feet; and one of four feet, half a mile below the forks.

The general direction from Lac Seul is north-east, but the main branch from near Cat Lake river seems to be coming more directly from the east, while the smaller branch is from the west-north-west, the two branches meeting in the same valley and the united stream leaving at right-angles to the branches. The western stream flows in a deep channel, bordered by a tall forest of poplar and birch. At two miles west a small lake is entered which has been gradually filling with silt and sand brought down by the stream from above. The inlet is on the western side, where a delta has been formed, stretching nearly across the lake. This is at present only a low grass and rush-covered flat, but shows clearly the effect of a settling basin for a small stream carrying fine sediment.

A series of falls or rapids amounting to twenty feet, just above the lake, is avoided by making a portage from the extreme northern end, 1,300 yards, to the river above. The upper part of the stream becomes very crooked, winding back and forth in the bottom of a valley between ridges of dark green schists running west of south. The immediate banks are low and generally composed of fine silt, the slope back being gradual, through swampy moss-covered ground, to a terrace of sandy material. Occasionally the stream cuts into the sides of the valley and shows stratified sands and silt.

The portage to Fly lake leaves this stream at a bend just below a heavy rapid where the river turns more to the east. An estimate by barometer readings gives the elevation of Fly lake as fifty feet above the stream at the foot of the portage, and the distance by pacing is half a mile.

Berens River Basin

The lower part of this stream was explored and surveyed by Mr. A. P. Low, of this Department, during the summer of 1886, while passing through to Hudson bay via the Severn river.[1] His route to the head-waters of the Severn led by Berens river to Fishing lake, just above the Grand rapids of Berens river. Thence he turned up a small branch coming from the northward, and by a number of portages reached the Severn river. Mention is made in his report of a large branch called the Mattawa, which rises near Cat lake, falling in at the south side of Fishing lake. From the fact that this branch apparently occupies the central position and is longer than any of the streams flowing in the basin drained by Berens river, it would seem that it should be considered the main part of the river. The lower portion is described as being a succession of chutes or short falls, with quiet water-stretches resembling the locks and reaches of a canal.

The larger lakes found on the course of the river to the eastern head-waters are, in ascending order, as follows: Family lake, on which the main Hudson's Bay Company's trading post for the inland district is established; Fishing lake, just above, the waters of which fall to Family lake by a heavy rapid, called Grand rapids, giving the name to the Hudson's Bay post. Above this, on the Mattawa branch, the first large lake is Eagle lake. This is followed by Rocky Island lake, Sandy Narrows lake, on which a Hudson's Bay post was at one time established, and Moose lake. These are generally connected by short river stretches, forming a chain lying in an average east-and-west direction. A long reach of river from the south, in which there are several rapids, drains Pekan-gi-kum (dirty water narrows) lake. Above this are Goose lake, Fairy lake and Upper Goose lake.

The detailed description of part of the river above Family lake to Moose lake is taken from unpublished information, the notes of the late Mr. A. S. Cochrane, who explored it in 1882. A rough sketch of the part above Moose lake to Pekan-gi-kum was made by A. W. Ponton, D.L.S., in 1888, while en route to the latter lake to locate and survey an Indian reserve.

Family Lake to Eagle Lake

The canoe route from Family lake eastward to Eagle lake leaves the main river and follows a string of small lakes in a more direct line, avoiding the long portage at the Grand rapids, and also the difficult navigation of the short stretch of river between Eagle lake and Fishing lake. By following an eastward extension of Family lake and ascending a small stream, with three short portages, a long, narrow lake is reached, which connects by a swampy channel with Eagle lake. The estimated difference in height between these two large lakes, Eagle lake and Family lake, is about fifty feet, and in time of highwater it is reported that an overflow from Eagle lake takes place down this valley. Eagle lake is very irregular in the outline sketched by Mr. Cochrane. The northern part, near the outlet, is full of islands, while the many channels around islands render it difficult to mark the eastern end.

The first rapid above is on one of a possible two channels, and has a fall of three feet. Farther up, the river expands into another lake, likewise full of islands. Mr. Ponton calls this Rocky Islands lake (Ka-sah-pah-wa-ka-muck Sakahegan). Isolated knolls situated near the shores are estimated to attain heights of one hundred and twenty-five and one hundred and fifty feet above the lake. This lake gradually contracts to river dimensions to the east, and a series of rapids occur, at which four portages are made, rising twenty-six feet to another expansion, which forms perhaps the largest or longest lake of the series—Sandy Narrows lake. This, like Rocky Island lake, is of very irregular shape. The route followed was mainly near the north shore, which maintains a fairly continuous line to the east-north-east. Bays running to the south-east, or large expansions partly inclosed by islands, are indicated on the sketch. On a point near the Sandy narrows was some time ago located a trading post of the Hudson's Bay Company. This may have been the "Albany House" marked on previous maps near this latitude. The extreme length given by Mr. Cochrane for this lake is thirty miles, in an east-north-east direction. The shores are flanked by hills averaging one hundred and fifty feet high.

The river enters at the north-east corner and comes from Moose lake, eight miles above, by the course of the river. In this distance the falls aggregate forty feet, with portages at four points. The northern branch above this, Crooked-mouth river, forms a route to Trout and Deer lakes to the north, and enters Moose lake at the north-west corner. The portage at the head of this branch, over the height-of-land, is in direct distance five miles north of Moose lake.

The main stream appears to enter at the south and comes from Pekangikum lake, at a distance of thirty miles. In this distance the river widens out in several narrow

[1] Annual Report, Geol. Sur. Can., vol. II. (N.S.), 1886, part F.

lake-like expansions, dotted with islands. Nearing Moose lake, it makes a long detour to the westward and back again, finally falling into a narrow arm at the south end, at the Eye rapids. There are four other rapids and portages on this stretch of river. The portages are mostly under a quarter of a mile, except one, which is three-quarters of a mile long.

Northern Branch, Berens River

Mr. Cochrane passed down by the northern branch through Moose lake, Sandy lake and Eagle lake to the Grand rapids. A few extracts from his notes serve to show the appearance of the country, on this route, at that time.

"The height-of-land portage (from the basin of Severn river) crosses a very low hill (about forty feet), at the south end, but it is for the greater distance over low marsh ground with some muskeg; and until Moose lake was reached the Crooked-mouth river continued to pass through low swampy ground. The only change in the country noted to Sandy Narrows lake is in its timber, which is mostly better, owing, no doubt, to some good soil being near the river. Indeed, in two or three places good clayey soil was seen, but only in small patches.

"The shores of Moose lake have all been burned over long ago, and are now characterized by brulé and second-growth. On other parts of this river to Sandy lake some good tamarack has been seen, occasionally twelve to fourteen inches in diameter. Spruce is about the same size, while Banksian pine is not larger than ten inches.

"Sandy lake, through which we passed (and at the foot of which I obtained a very satisfactory observation for latitude, 52° 04′ 54″) is, generally speaking, surrounded by rocky hills averaging 100 feet, now fairly covered with the usual second-growth, amongst which is a good deal of green timber. The shores of this lake, as also those of the next below (Rocky Island lake) are mostly rocky, though an occasional short sandy tract is to be seen between the rocky points. About three-quarters of the way down the lake, is what is called the Sandy Narrows, at which the lake becomes constricted and is bordered on both sides by low sandy banks. The bottom, except for a narrow channel at one side, is also sand, and the water too shallow for canoes.

"The river connecting these lakes is a tolerably large one. The portages are made mostly at falls and chutes with steep tracks. They are, however, all short ones and in good order. Soil of good quality was seen at only one point, viz., the second portage below Sandy lake, where it is a stiff grayish-clay with a slight covering of dark sand. It does not, however, appear to extend beyond the point across which the portage has been made."

The notes relative to the rocks of this part of the river and lakes traversed are given below:—

Moose lake, south side: Coarse, dark-gray, massive granite; glacial striæ, S. 85° W.

Eastern end of Sandy lake: Dark-gray and grayish-brown gneiss; dip N. 30°; striæ, S. 75° W.

Two miles from east end of above lake: Dark-gray gneiss containing large quantities of hornblende and some iron; highly polished surface.

Sandy lake two miles east of Sandy narrows: Very coarse dark and light brownish-gray gneiss, containing a few small transparent amber-coloured grains of quartz and much hornblende; dip N.E. at a high angle; striæ, S. 75° W.

Western side of Eagle lake: Coarse dark and light gray micaceous gneiss; dip, N. 20°.

Eastern end Family lake: Dark gray gneiss; dip, E. 25° N.

Dark gray gneiss seems to be the prevailing rock of all this region.

Indian Reserve

The land reserved for the Indians on the upper part of this branch of Berens river is a small tract situated on the north side of a long arm or narrows, running to the eastward, from a lake to which the name Pekangikum is given. The river enters at the eastern end of this area, coming from Sturgeon lake by a short stretch of river half a mile in length, in which there are two rapids. The Indian reserve appears fairly well timbered—principally with Banksian pine of slender growth and some spruce. The Indians have been able, in building their houses, to obtain timber of suitable size for the walls and rafters, and spruce of a diameter of fourteen inches is fairly plentiful. The shores of the lake are rocky, but strips of country appear inland, on which there is probably a fair quality of soil, though the surface is generally sandy. On one of the islands in the larger part of the lake, soil of good quality (clay) was seen, on which the Indians were growing potatoes. No doubt there is better land for this purpose on the reserve they have selected, but as they make their summer camp on a small island near the deeper part of the lake for the purpose of fishing—by which they mainly subsist—they naturally utilize the nearest land for their summer gardens.

The Dirty-water narrows, which runs eastward from the reserve, is about eight miles in length, and averages very little over a quarter of a mile in width. The shores are

mostly rocky, but not very high and generally moss-covered, with a thick growth of small spruce and Banksian pine. At the end of the bay or arm, an abrupt turn south is made to the first rapid above the lake. This is in a narrow gorge, but at ordinary water there is very little fall (three feet, 8th July, 1893), and the portage is ten yards across a low rocky barrier, stretching into the channel. In high water, this rock would be covered and the river must fill the whole width of the gorge. Half a mile south of this, at the south-east corner of a small basin, there is a fall of eleven feet over a wide ledge at the western end of Sturgeon lake. The high-water mark in the basin between the falls was six feet above the actual level, an effect due to the contracted channel at the lower fall, compared with the wider one of the upper.

The lake above this is a long narrow one, with a great number of islands scattered along its length, which is nearly seven miles. The width does not average over a mile. The direction of the length of the lake is, for the first half, east by south, then north-east. The shores are mostly high rocky hills, in many places burnt over, and the timber is small. Near the north-eastern end, the shores along the southern side become low and better wooded. The river enters on the west side, one mile from the extreme end of the lake, flowing through low land, evidently a delta deposit. It is now well timbered with spruce, poplar and birch, of fair size.

Above Sturgeon Lake

The river makes three long bends before any swift current is encountered, and at about seven miles the first rapid is met. This is situated about three miles in a direct line north-east from the lake, and is called Mick-kai-ame Pow-estick. There is here a fall of thirty feet over gneiss, very much broken by veins and dykes of red granite. The portage is on the north side, 350 yards in length, over a steep hill of sand and boulders. This appears to be a ridge of drift material which crosses the river at this point, and, by Indian report, continues to the southward to the Trout lake ridge.

Above this the river turns more to the east, and several small rapids occur, up which the canoes are handed, till at three miles the stream divides, the northern branch, Throat river, being the one followed on the route to Cat lake, the southern, the route toward Woman lake. These two branches are of much the same size. Half a mile up the southern branch is the Otter fall, of fifteen feet, where there is a portage of two hundred and thirty yards. Above this the river, to the next fall, comes from the south; the banks are mostly low and rocky and the timber is a mixture of spruce, tamarack, poplar and birch. After following a crooked course of two miles of this nature, there is another fall of eight feet, Pin-un-ge Pow-estick, or Child falls, with a portage of seventy yards on the south side, through small spruce.

From this fall to the mouth of Windfall creek, eight miles in direct distance to the east, the river gradually rises by small rapids, there being three portages, the first at two miles across a sharp bend through woods of Banksian pine to avoid a rough rapid with fall of five feet, the second at a long rapid, and the third a short distance above, where an island, on which is the portage, divides the channel. The banks are mostly low and swampy to past Windfall creek, and with sluggish current to Hair lake. Tamarack and spruce are the principal trees, small in size, growing in low, swampy ground. Occasionally a small knoll is seen, with poplar and willow scrub. The channel from the mouth of Windfall creek to Hair lake is nearly straight, running about east and west, the distance being about eight miles.

Owl creek, a small stream, enters a mile below Hair lake, coming from the south-east. Hair lake is about one mile and a half in length, lying north-and-south. The river enters at the south-east corner and leaves by the south-west. The distance across the southern end is about a mile, and the shore, there low, slopes gradually to the lake, of which the bed appears to be shallow, as most of the southern part of the lake through which we passed is dotted here and there with slender rushes, possibly suggesting the name to the natives. In the northern portion there is deeper water, and whitefish are said to have been caught there.

A distance of only a mile separates this from Goose lake, and at half the distance is the White Dog fall, a descent of eighteen feet.

Above Sturgeon lake, on this branch, there are but three lakes of any size, namely, Goose lake, Fairy lake, and Upper Goose lake. These are all situated near together, separated by short river-stretches. The first is four miles in length, by one mile wide, lying east-south-east and west-north-west. The river enters at the east end and leaves at the west. Hudson's Bay Company had an outpost established at the eastern end in former years, but it is long since abandoned. A short length of river connects with Fairy lake to the south-east. At a mile up this is Woman fall, the highest on this part of the river. Here there is a drop of forty-five feet, in a narrow gorge, over ledges of gneiss forming a series of steps. The portage is on the north side, of one hundred and twenty yards, through poplar and spruce woods. A little farther on another fall occurs, of twenty feet, with a portage of two hundred yards. This ends at a small lake, from which a wide channel to the south connects with the north end of Fairy lake, which is

thus at least sixty-five feet above Goose lake. We entered at the north, and travelled a mile and a half along the eastern shore to the mouth of the incoming river. The main body of the lake stretches away to the south, as a narrow area of less than a mile in width and perhaps five miles total length. The south-eastern shores are low, the higher land bordering the western side. The third lake of this series is called Upper Goose lake, or, more literally, "the lake where they kill geese," and is three miles east of Fairy lake. The river connecting them is broad, deep and sluggish. The lake is less than five miles long and is slightly wider than the last. The longer diameter lies east-and-west, the river entering at the western extremity.

Above this are two small lakes through which the river passes, and between them is a fall of four feet at the "Eagle rapid." A mile above the upper one, the river divides, the eastern branch being the Whitefish river while the southern one is the main stream. This then turns south and passes through a low swampy tract for three miles, when, nearing some rugged hills, it becomes less sluggish and small rapids are met with. The main part of the stream then turns to the west, coming from a series of lakes in the hilly region. A small branch falls by a series of shallow rapids to this stream, which branch was followed in order to reach the height-of-land to the east, making two portages of one hundred and eighty yards each, rising ten feet to a swampy tract in which the stream is deep and sluggish but very crooked. Portages are made at several shallow rapids, to the height-of-land. The direction of this latter part is to the south-south-east and a distance of twelve miles, the estimated fall in which is over eighty-five feet.

Southern Branch of Berens River or White River

The largest of the tributaries of Berens river, coming from the south, is the White river which enters at Pekangikum, at the extreme southern end of the lake. This stream comes from a point directly south at a distance of twenty-five miles, and passes through two or three crooked lakes, falling in that distance over two hundred feet. This estimated fall is merely the sum of the falls on the river with an estimate for current. The greatest is that at the first long portage where it is sixty feet, the rest being made up of a number of smaller rapids and chutes. There are twelve portages to reach the height-of-land, mostly short. The last is the longest, being over a mile in length. In following this small stream upwards, it gradually contracts in size, until near the head-waters it is so small that the whole distance between the last two lakes has to be portaged. This portage, over a mile in length, starts in a tamarack and spruce muskeg, moss-covered, but eventually reaches higher ground with mixed timber, mainly hills of sandy, boulder-strewn material. The prevailing tree is Banksian pine, and towards the eastern end of the trail this has been thinned out by fires and wind storms, leaving a grove (at the far end) averaging ten to twelve inches in diameter.

Just below the lake-stretches, near the height-of-land, the river cuts through sand hills, forming a deep valley, and at one of the portages clay was noticed resting directly on the rock, the sand evidently lying above it.

Estimated Heigths of Lakes

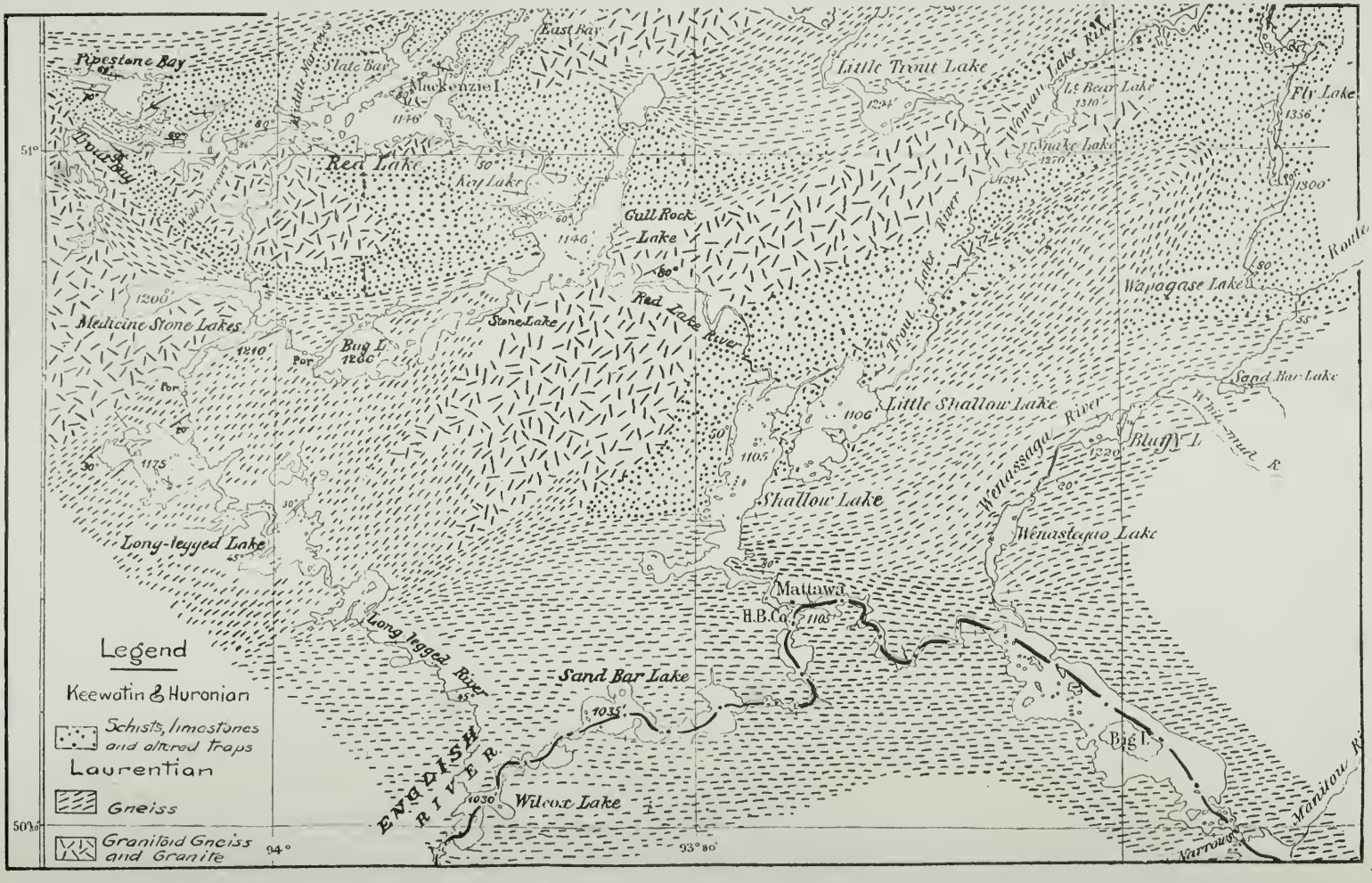
A series of estimations of the falls and rapids in the river was carried through from Lac Seul to Pekan-gi-kum, on Berens river, via White river, and thence up the eastern branch to the head-waters of Cat Lake river, and south by Trout Lake river to Lac Seul.

The results are given for those lakes in the area drained by Berens river, and are the estimated heights above sea-level in feet, assuming Lac Seul as being 1,140 feet.

	Feet.
Lake at height-of-land, White river	1,250
Lake at latitude 51° 25′, on White river	1,225
Lake at latitude 51° 33′, on White river	1,175
Below Long Portage, latitude 51° 37′, White river	1,100
White lake, White river	1,040
Pekan-gi-kum lake, Berens river	1,037
Sturgeon lake, "	1,051
Hair lake, "	1,178
Goose lake, "	1,196
Fairy lake, "	1,261
Upper Goose lake, "	1,262
Lake at height-of-land to Cat Lake river	1,350

GEOLOGICAL FEATURES

In the country under consideration, the rocks exposed are all Archæan, consisting of geisses and associated granites, classed generally as Laurentian, and folded schists and greenstones of the Huronian. In many respects these rocks are counterparts of



Southwest Corner, District of Patricia.

those found in the district farther south on the Lake of the Woods and Rainy lake. The northern boundary of the large Huronian (Keewatin) areas already explored there, is roughly on a line from Rat Portage to the foot of Minnietakie lake. North of this a band of gneisses occupying the shores of Lac Seul and the English river, is succeeded by a similar series to that on the south. The irregular form assumed by these Huronian areas, in both districts, is no doubt the result of simultaneous crustal movements. The Laurentian gneisses are the prevailing rocks of the whole region, and their association here with the folded schists, greenstones and rocks of apparent sedimentary origin, is of special interest in view of the auriferous nature of many of the quartz-veins found cutting similar rocks in the vicinity of Rainy lake and Lake of the Woods.

[Most of the rocks classed as Huronian in this report should, under the nomenclature now in use, be called Keewatin.—W. G. M.]

Former Explorations

A part of the area has been briefly referred to in former reports of this Survey:—

Dr. Selwyn,[8] in 1872, in describing a journey from Lake Superior to Lake Winnipeg, passing by English river through Lac Seul, calls attention more particularly to the soil and drift deposits, and instances the sands and clays in the valley of the English river as being of greater extent, than farther south and west on the Winnipeg river, except perhaps on the lower part near Lake Winnipeg. In speaking in a general way of this district he says[9]:—"There are no prominent hills or even ridges; the highest elevations do not probably exceed four or five hundred feet above the intervening waters; and I think it is no exaggeration to say that the latter occupy fully one half of the whole surface area of the region. The surface is gently broken and undulating, and often rocky, but occasionally both lakes and rivers, are bordered either by extensive swampy flats or by banks of stratified sand, silt and clay, which often rise terrace-like at a short distance from the water's edge. The point on which the Lonely Lake Post stands is formed of these deposits, and to the westward of the post, along the north shore, they are exposed in cliff sections for several miles. At the junction of the Mattawa [Shallow Lake river] and English rivers, where a small Indian village and trading post is situated, presided over by Chief Pierre, there are similar banks of sand and sandy clay, resting on the ordinary gray Laurentian gneiss, which is exposed along the water's edge. The banks here rise steeply to about thirty feet above the water, and for some distance inland the country seems to be tolerably level, and the soil on this part of the river appears to be generally of fair quality."

Dr. Bell,[10] who accompanied Dr. Selwyn on this expedition, reports more fully on the rocks met with. Of those seen on Lac Seul or Lonely lake he says[11]:—

"The rocks observed around the shores of the western section of this lake consist entirely of Laurentian gneiss, all having a west-south-westerly strike. We noted many varieties among these rocks, but none of them are remarkable or require special description. . . . About the outlet the gneiss is very micaceous ,and is cut by numerous granite veins, mostly running with the strike which is here nearly due west. The granite, as in many other places, may here indicate the proximity of a band of Huronian schists. The Indians at the mouth of the Mattawa [or Shallow Lake] river showed us specimens of a soft, gray, uncrystalline slate, which they carve into pipes, and informed us that they obtained it from the solid rock at Omimini Sagaigan or Red Paint lake, which, from their description, would appear to lie about five miles north of the junction of the two rivers. These facts appear to show the existence of another band of Huronian rocks, which, judging from the strike, would be identical with the one observed before the junction of the English with the Mattawa river."

In 1883 Dr. Bell again visited this region and made a survey of the Mattawa and Red Lake rivers to Red lake. In the Summary Report for that year, he gives a short account of his route to Red lake. The notes bearing on the geology of this area are contained in the following paragraph.[12]

"A very careful track-survey was next made of Red lake itself, as its shores proved to be of great geological interest. The whole lake (which is of considerable size) lies within a wide belt of Huronian rocks, among which several of the rarer varieties are well developed, and they were found to contain some interesting minerals. The narrow belt of Huronian rocks, which, in 1872, we conjectured would pass a few miles to the northward of the junction of the English and Mattawa rivers, was actually found in the position and strike it was then supposed to have."

The Laurentian

Gneisses referred to the Laurentian were seen on the White and Berens rivers, on Lac Seul and on the English and Mattawa rivers. At the head-waters of Berens river,

[8] Report of Progress Geol. Surv. Can., for 1872-73, pp. 8-18. [9] Ibid., p. 16. [10] Ibid., 1872-73, pp. 87-111. [11] Ibid., p. 103. [12] Ibid., 1882-83-84, p. 5

large masses of unfoliated granite seem to break into the gneisses and in other parts similar granite cuts the darker rocks of the Huronian. In the Lac Seul area the strike is very uniform, generally trending to the west, but this extends northward only a few miles from English river. On the river from Long-legged lake the western trend is maintained to near the outlet, and on Shallow lake, to a point about one-third the distance up the lake. Up the Wenassaga river this uniformity of strike does not seem to continue far from Lac Seul, as on the portage below Bluffy lake the rocks become very much crumpled up. This crumpling is seen in the rocks on the east side of Shallow lake and shows a line of weakness running from south of Bluffy lake to Shallow lake and thence to the outlet of Long-legged lake.

Rocks of Lac Seul or Lonely Lake

The beds from the outlet eastward are generally gneisses and mica-schists, with interbedded light-coloured granites all trending about east and west. Near Big island they run west-south-west and east-north-east, and at the narrows at the western end of the island, many red granite veins break into the beds, altering them to a slightly lighter gray. On the south side of the island is a long exposure of a reddish granite which breaks easily, like a sandstone. This is, however, found to be cut by the red veins of granite which also cut the gneiss. At the Shanty narrows, the rock is a light granite or slightly foliated gneiss interbedded with garnetiferous mica-schists, and the strike bends from west-south-west to south-west, but quickly turns again to an east and west direction. At the Manitou narrows the rock is a whitish granite, with a few streaks of dark foliated rock made up of fragments flattened out and somewhat rounded at the ends. Near the long point west of Stony point, a small island is found to be composed of light-coloured crystalline granite, with slight signs of foliation.

Three miles east of Stony point, a small island, connected by a gravel bar to the mainland, is composed of dark-green bedded rocks. They are standing on edge, striking about east-north-east and are found on several of the islands lying on that line. The main shore to the north is of granite, very like that on Big Island, and it here contains many fragments of the green rocks, forming a brecciated contact. A wide dyke of graphitic granite cuts through the beds on the point, but whether it connects with the granite of the mainland or cuts it as well, was not ascertained.

On English river, the beds at the outlet are very much wrinkled, and at the first rapid, bands of dark mica-schist and dark-gray gneiss, interleaved with coarse whitish granite, are seen. Below the second rapid, on the point opposite the portage, the beds are very much broken and twisted, so that pieces of the darker bands are broken off and carried forward in the mass. A coarse gray granite showing some foliation occurs at Mattawa, and is followed two or three miles up the Mattawa river by dark hornblende-schists with a general east-and-west strike. At the elbow, about half way to Shallow lake, red granite dykes are seen cutting the schists. The south-western arm of Shallow lake is principally surrounded by hills of gneiss and granite of the Lac Seul type, ending at a point three miles and a half north of the outlet, where the gray gneiss is found to contain rounded masses of darker inclusions. Across the lake, half a mile north, dark fine grained mica-schists, very much crumpled, are cut by salmon-coloured granite. These may possibly be altered beds belonging to the same series as the rocks of the north-western part of the lake, and this point would then be about the northern limit of the Lac Seul Laurentian band.

Below Mattawa, the river widens to a small lake that discharges in a series of rapids, along the banks of which light granite-gneiss, running west-south-west is found, and occupies the sides of the stream to the next fall, the river running in a trough parallel to the strike. Bands of mica-schist become frequent, and on breaking through these to the south the river falls into Barnston lake. Gneisses which call for no special remark are seen on the banks of the lakes, forming expansions on this part of the English river.

The stream from Long-legged lake which falls into Wilcox lake was explored and mapped. The rocks are mostly a repetition of those on the English river and maintain a nearly uniform strike to the westward, varying locally, the altitude being generally vertical, but occasionally a dip of 45° south was found as the extreme variation. Fewer exposures are seen on these small rivers, owing to the current not being able to wear away the surface covering.

The northward continuation of the Laurentian of Lac Seul, on the Wenassaga river, is found to show some changes in character On Lac Seul a series of granites is found interbedded with mica-schists. On the upper part of the Wenastegao lake, and on the river above to near Bluffy lake, little change except that of the strike was noticed; but at the long portage, as noted before, the beds are very much crumpled and folded, over a short distance, and on Bluffy lake return to a uniform south-west and north-east strike. Following these beds north-eastward, they are found to curve slightly more to the east, and at the east end of the lake are running about west-south-west and east-north-east.

The gneisses are generally reddish to gray, and specimens taken from a small island near the eastern end, show layers composed of nearly pure quartz. On a smooth surface, this rock is seen to be made up of a series of lenticular grains which are the result of subsequent squeezing and perhaps shearing while in a plastic condition. The gneisses seem to have the same structure.

At the entrance to the river above this lake, is an exposure of dark gray felspar-mica gneiss. The grains of felspar are very even in size, of a light colour and surrounded by flakes of black mica. Streaks of granular quartz run parallel to the foliation. The next exposures are near the outlet of Sand-bar lake, where a ridge of dark gray gneissic schist crosses the valley. Along the north shore the rocks are mostly a dark mica-schist, cut through by dykes of light, very coarsely chrystalline granite. On the river above, the schists form another dam and fall, where light gray gneiss is followed by a wide band of fine-grained schistose gneiss. The rocks exposed on the river above are probably of Huronian age, but the contact between the two series must be concealed by the surface covering, as the river for a short distance runs through a low swampy flat where no rock is seen.

Rocks of Long-Legged Lake

Just at the entrance to the lowest lake of the series a band of dark fine-grained horneblende-schist is found at the rapid. The strike of the gneisses about a mile below this is almost directly west, but half way between, a dark fine-grained gneiss strikes to the west-south-west, and at the upper rapid, where the fine-grained hornblende-schists are seen, the strike has turned to the south-west, which direction of strike is maintained to the west end of these lakes. It is thus shown by the line of weakness traced to the eastward, by crumpling and a change of strike, that a distinction is here to be drawn between the Lac Seul type of Laurentian, as found in the river, and the gneisses of the Long-legged lakes, which all trend to the south-west, or nearly at an angle of 45° to the former rocks.

On the lower lake are chiefly granites and gneisses. On the south-east shore are gneisses with a light porphyritic granite, and at the south end of the bay, the granite is found to hold dark oval patches or inclusions, while on the point south of the opening to the second lake, are masses of dark hornblende-schist which look like outlying fragments of Huronian, included in the foliated granite. These rocks are immediately followed to the west by dark gneiss. Passing through a narrows, the second lake is entered, and here the rocks are generally gray and red granite-gneiss; the exception being a small island of light-green fine-grained rock resembling that of the Huronian, but its relation to the surrounding gneiss could not be seen. On the west shore, a band of dark schist touches the shore and occupies a long island, but is followed by light-coloured gneiss, and this again by reddish gneiss and granite. On the narrows just at the entrance to the last lake, a band of dark-green coarsely crystalline rock was found, similar to some of those seen on the Red Lake river, and there supposed to be an eruptive associated with the Huronian series. Near the west end of this bay, another band of dark rocks was seen, the intervening beds being generally light-coloured gneisses.

This recurrence of the dark bands at intervals of two or three miles suggests the possibility of their being the lower edges of a series of folds of the Huronian. They seem to be accompanied in nearly every case by a few broken patches of dark inclusions in the adjacent beds, and in the case of the first one, on the west side of the lower lake, the continuation of the band on the south shore was indicated merely by such fragments in the gneissic rock.

On the hills to the south-west the beds are horizontal, but soon take a dip to the south-east; a mile east the dip is south-east 20°, at the second lake it is southeast 30° to 45°, and at the outlet the beds are almost vertical.

The absence of anything in the nature of mica-schist is a character of the gneisses of Long-legged lake and also of those to the north-east on Bug lake and Gull lake, and the grouping of these rocks together, as being of common origin, is suggested from their being nearly on the same line of strike and separated by a very short interval in distance.

To the north-east of this group of lakes, on Gull lake and the small lake lying to the east, is found an area in which light, slightly foliated granite is the prevailing rock. This, at its contact with the Huronian of the west shore, has sent long, finger-like masses between the beds, separting them. Fragments are found in the granite at some distance from the contact, and a band lying to the south of the Huronian seems to be made up entirely of these fragments cemented together by the granite. At a greater distance to the south, these fragmentary rocks gradually assume the aspect of altered beds cut into by the granite in veins and dykes.

On the Upper Medicine Stone lake, a mass of granite forming a triangle between the two lakes, deflects these altered beds to the south-west, and it is possible that the gneisses of the lakes to the south of this may be a continuation of highly altered beds

similar to those above, but in which the gneisses and foliated granites are also cut by a red granite. The larger dykes of granite cutting these gneisses at the western end of Long-legged lake are of a light red, and suggest a possible connection with the large granite mass of the west shore of Medicine Stone lake, while the granites and foliated granites found cutting, and interbedded with, the gneisses and dark-green schists of the middle and eastern lakes, are probably connected with the granite area east of Gull lake.

Rocks of Trout Lake

The Trout lake area is probably all Laurentian, but the existence of Huronian in the immediate vicinity is to be conjectured from dark metamorphosed rocks in fragments and small masses held in the gneisses at several localities.

At the outlet of Little Trout lake, a small band of dark rocks very much seamed by red granite veins, is accompanied by granites and gneisses. This, by reference to the map, will be found to be a probable continuation of the south-west extreme of the Woman lake beds. The south shore on the continuation of this strike was not visited, but it is quite probable that traces of this band might be found connecting this area with the Red lake series.

Another locality presenting somewhat similar features is at the western extreme of Trout lake, where the gneiss contains spotted bands looking like conglomerate pebbles of dark rock with a matrix of lighter colour.

On the narrow water connecting Little Trout lake with the larger one are beds of gray gneiss, the foliation running about south-west. The same strike was found to be common to the gneisses of the south-eastern part of the lake. Few exposures are seen on the south-west side and they are of an unfoliated granite, but on the extreme western end they become more gneissic, running about west.

On one of the points at the entrance to the western bay occurs the spotted band mentioned above. The whole point is foliated in a direction about north-west and south-east, the plane of foliation dipping south-west 60°. Half a mile north-west the point is a mass of reddish gneiss; the foliation is distinct but the mass is lighter coloured than the last and is nearer to a granite. Across the bay to the north, on the extreme north-western shore, the rock is a dark gray gneiss with foliation running to the north-east, cut by many seams of red granite. Eastward on the north shore, the gneisses are light gray and red, and of much the same character, preserving a general north-east and south-west strike.

North of Red lake, the Laurentian rocks are found to touch the northern shore of Pipestone bay, and the hills north of a long arm on the north side look like granite, while on the lake, veins of granite cut the schists. The contact is evidently near at hand, and a short distance up the Whitefish Spawning river is an exposure of somewhat greenish granite, which seems to include small masses and crystalls of a dark green hornblende or pyroxene giving it a darkened colouring.

Farther north, the granites are lighter in colour and show slight foliation. On the small lake above Little Vermilion lake, the rock is a light-red fine-grained granite, and little variation, except in respect to traces of foliation, is observed on the upper waters of this stream. Red granite is observed on the height-of-land portage, and on the lakes forming the head-waters of the streams flowing north and south.

The granite at the head of Pipestone bay, near the contact, shows some traces of green colouration from the Huronian rocks, more especially along cleavage planes. The foliation is slight and the colour is reddish, mottled with gray, fine, granular material which increases near the contact. The broken inclusions of Huronian schists, so common at other contacts, were not noticed along the north side.

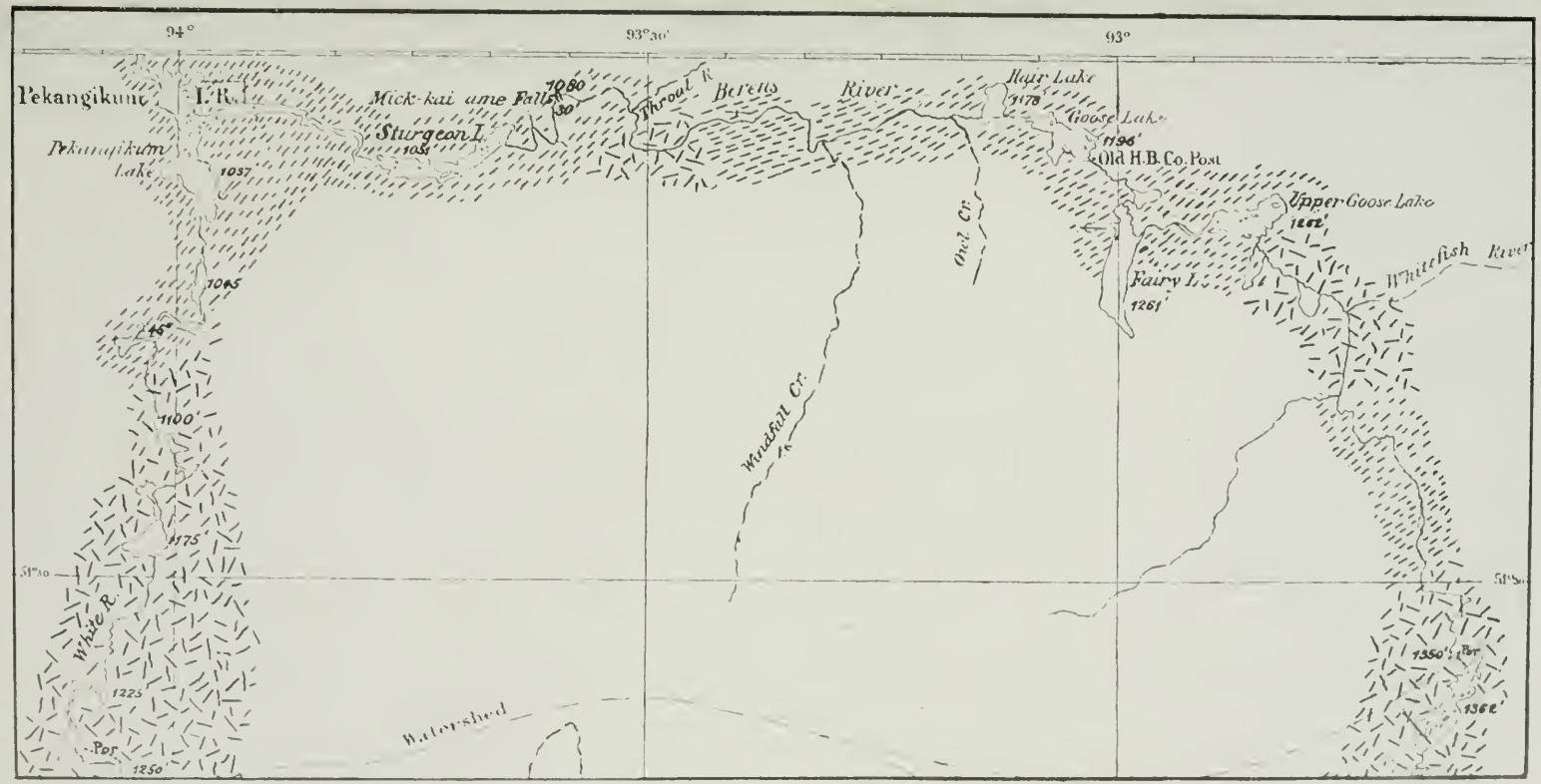
Rocks of Berens River

The geological character of the country lying north of the height-of-land to Berens River is given altogether by exposures of gneisses and granites, with intrusive dykes, and the small areas of reddish granite mentioned as being near the height-of-land and in the vicinity of the Mic-kai-ame fall. A strongly banded gneiss is found on the lower part of White river and eastward beyond Sturgeon lake, when granite of a light reddish colour, possibly intrusive, is followed by gneisses cut by many dykes of granite. The head of the eastern branch explored above Goose lake is in a small lake of which the shores are mostly composed of red granite. This extends southward to near Sha-boom-ene lake, where gneiss is again found in contact with Huronian schists, the contact being of a broken nature, generally following the strike of the schists to the south-west. Angular patches of dark rocks are found, included in the gneisses as at other localities previously described.

Granite Areas of the South Shore of Red Lake

The following notes refer to the granites of the south shore of Red lake:—

The first of these, near the outlet of Red lake, is altogether surrounded by the Huronian of the Red lake area. The contact, as far as it could be traced among the



Pekangikum Lake and Berens River.

(See map page 34 for geological legend.)

islands, is evidently that of an intrusive mass breaking up through a bedded series. Fragments of the beds are included in the granite and alteration of both fragments and adjoining beds is also a feature.

The south shore of the western half of the lake is also found to be of red granite of about the same general aspect, being light in colour and rather fine grained. This appears to penetrate into fissures and cracks in its contact with the Huronian. The line of contact which crosses the arm of the lake, touching the north shore and cutting off points, is found to take a somewhat sinuous course. The break does not always follow the bedding of the schists, but in many places is seen to cut across them at various low angles.

This mass is probably surrounded by the schists and greenstones of the Huronian, making a long oval area lying east-and-west, as at the western end the schists are striking to the south of the granite area, and again on the south side, green fine-grained beds readily correlated with the clastic rocks of Red lake, are met just north of Medicine Stone lake. This probably forms a narrow belt, which, passing north of Bug lake, joins the main mass on the west side of Keg lake.

This mass, with a skirting of Huronian, resembles in shape those areas already mapped in detail near Rainy lake, but the broken nature of the contact on the north side would suggest a rather violent separation of the narrow band from the main series and the interposition of an eruptive mass of granite.

Outlying bands of gneiss south of the narrow band of Huronian mentioned above, are possibly highly altered schists. These are seen on the north shore of Medicine Stone lake, the south shore of Upper Medicine Stone lake, and on the stream south-east of a small lake lying to the west. Other masses of the red granite are found between the two Medicine Stone lakes and on the small lake to the west. The relation of these isolated areas of granite to the Laurentian gneisses of the region to the south-east has not been clearly determined.

Huronian

The series of schists, limestones and bedded materials originally of volcanic origin, here mapped as Huronian, in many respects lithologically resemble the larger areas to the south which have been designated by the local name Keewatin; but the presence of dark-blue limestone and of conglomerates with jasper pebbles, both very similar to those of the typical Huronian area north of Lake Huron, renders the propriety of extending the name Keewatin to these rocks doubtful. The Couchiching, supposed by Dr. Lawson to underlie the Keewatin in the Rainy lake country, is possibly represented here by the small area west of Shallow lake, but strata which most resemble the typical rocks of this series are found on Gull Rock lake, and are seen to be only highly altered beds in contact with the Laurentian, which when followed along the strike, away from the contact, change very materially and resume the general aspect of the rest of the Huronian.

The contact with the gneissic rocks and granites of the region was found to be generally of a brecciated character, the gneisses and granites while in a plastic condition surrounding and inclosing the Huronian schists.[13]

Rocks of the Shallow Lake Area

As before noted in the Summary Report for 1883, a small patch of Huronian rocks was seen on this lake by Dr. Bell. The junction of the Laurentian gneisses with these rocks occurs on the west shore, at about three miles and a half north from the outlet. Gray gneiss, striking westward, occupies the shore to the first large bay. On one of the islands in this bay on which the Indians have small gardens, is a series of black gneisses very much twisted. On the mainland opposite, the gray gneiss gives place to dark gneiss very much seamed with granite veins, and in the gneiss are included fragments which apparently are broken from the darker series. The exact point of contact was not seen, but the attitude of the beds on each side, is that of a dark series very much twisted up by heat and pressure, becoming broken and fissured and finally disappearing in a much altered condition as fragments held in the mass of adjacent gray gneissic rock of which the strike is directly across the general trend of the dark beds.

Following the shore northward, the beds very soon lose their folded character and are found with a uniform strike to the north, afterward turning to the north-east with an easy curve. The general trend of the series is nearly parallel to the shore-line, so that the bed which is found at the mouth of Red Lake river would cross the points at the north-west corner, touching the shore at the bottom of the bays, thence turning south, would pass just clear of the west side and finally would be crumpled up near the contact, thus on the lake shore a very narrow section of the series is found. In going westward, this section consists of, first, dark semi-crystalline schists or gneisses,

[13] With further reference to the nature of the contacts or lines of junction here described, and the inclusion of Huronian fragments in the gneissic rocks, see Lawson's reports on the Lake of the Woods and Rainy River. Annual Reports, Geol. Surv. Can. (N.S.), vol. I., p. 62CC and vol. II., p. 23F.

a band of dark-green hornblende-rock, in places rendered schistose and in others mainly a trap, and lastly the beds at the mouth of the river, which are a dark-green, fine-grained rock, well stratified and apparently clastic,, resembling beds within the larger Huronian areas. On the river, few exposures are to be seen. At the foot of the first rapid, dark hornblende-schists are exposed, followed in a short distance, at the second fall, by coarsely-crystalline hornblendic eruptive rock, which is similar to that on Shallow lake. The thickness of the section can scarcely be estimated, as the western boundary was not seen, but the presence of angular granite boulders, which had evidently not been carried far, containing inclusions of dark rocks, would place this line just above the second rapid, or at a distance of two miles from the mouth of the river. A small eastward extension of the series is found on the narrow point separating the two Shallow lakes. These beds have an average south-west strike, and appear to have formed a nearly separate area from the rocks of the west shore, while a series of granite with a varying amount of foliation has occupied the gap between, which is probably one main break with several lesser ones in the form of dykes, generally cutting into the mass along the bedding planes. The islands in the centre of the lake and near the east shore are all of gneissoid granite. The main shore at the outlet of Little Shallow lake, is a light granite with greenish tinge and numerous small crystals of light-green hornblende. This rock probably occupies the trough or valley of the connecting stream, as it is found again at the mouth, on Shallow lake.

The Huronian rocks extend to the eastward on Little Shallow lake, nearly to the mouth of Trout Lake river and occupy the west shore to near the south-west corner. The division line passes not far from the west shore making a light curve. The long point from the east shore appears to be mainly reddish granite and the small island opposite, near the shore is composed mainly of gneissoid granite. At the contact, near the south-west corner of the lake, the beds are found to show a great amount of metamorphism which decreases as the line of contact is left. A coarse-grained, whitish, gneissic granite, containing silvery scales of mica and whitish felspar; is found in contact with a dark gray gneissic schist, which is succeeded by dark-green, rusty-weathering, coarse-grained schist and a dull fine-grained gneiss. The shore northward for a couple of miles is occupied by a fine-grained, dark gneiss which resembles that of the west shore of the larger lake. From opposite the long point to the outlet, several beds are found of a dark, fine-grained stratified rock containing a great amount of magnetite and specular iron. These beds may prove to be of future use as ore-deposits.

The north-eastward extension of the series follows the high ridge west of Trout Lake river, crossing this stream somewhere below the big fall. The first exposure is of a light grayish-green, quartzose mica-schist, which is probably a squeezed gneiss. This is associated with beds of a dark green to gray fine-grained material which is probably an altered sedimentary rock.

The granite dyke, which breaks into the mass at the fall, is followed above, on the river, by dark-green hornblende-schists, and by a coarser crystalline hornblende-rock resembling the bands of eruptive rock on the north side of Shallow lake. The northward extension above is hidden, and we next see the granites which extend to Trout lake. It is quite possible that the beds, which here are striking north-east and south-west, may continue to the north-eastward and join the area of Huronian exposed around Woman lake, but of this there is no certainty.

Rocks of the Woman Lake Area

Our explorations in this district were along two routes near together and probably at the extreme western edge of the Huronian area, as the beds very likely run much farther to the eastward than we had the opportunity of seeing.

Our routes were from Shaboomene lake (in the Cat lake basin) through Woman lake and down the Trout Lake river, and again from Trout lake eastward via a long narrow lake to Woman lake, thence up stream to Clearwater lake (lying east of Woman lake), directly south up stream to Fly lake and thence down by the Wenassaga river to Lac Seul. On the former route, we met with the western boundary of this series on the Shaboomene lake, where a series of foliated granites are found in contact with dark-gray schists and garnetiferous gneisses, which appear near the western border of the series. The gneiss is cut by dykes of light-coloured greenish-gray trap which is not seen in the foliated granites to the north. The beds following this are of green schist. The western boundary of the Huronian, includes a narrow strip along the west shore and cuts across a bay to the south side of the lake, leaving the northern part and a small patch on the south-western side, in the Laurentian; while part of the west shore, the south and the southern half of the east shore are composed of Huronian rocks. The bay at the south end, from which the portage is made, is surrounded by rather steep shores of light-green altered volcanic rocks, fine-grained and compact, with many small shrinkage cracks filled with calcite.

The portage to a small lake above Woman lake is over a high ridge of dark green, squeezed and altered quartz-porphry. The same bed is found again on the north end of

Woman lake on a continuation of the strike to the south-west. Down the west shore, the succeeding beds are evidently of volcanic origin—light-green diorites and ashy-weathering agglomerates. Near the south end, at the narrowest point, a dark series of cherty rocks follows the west shore and passes away to the south-west, followed again at the bend by beds of dark, fine-grained, thin-bedded rocks, of which some are thoroughly filled with iron pyrites and magnetite. Medicine rock, just out of water in the centre of the channel, is apparently a mass of ore, while the weathered pyrites supplies the Indians with "medicine."

In the river at the outlet of the lake, the last rock-exposure is of a dark green-felsite, and on the first lake below—Little Bear lake—the rock is a gray gneissoid granite with included fragments of a dark colour which were supposed to be highly metamorphosed pieces from the Huronian.

The route from Trout lake through this area is up a very small stream to the eastward for about five miles to a small lake. Here dark, green eruptives are seen, but the portage of two miles to the south takes us back again into gneiss, and the long lake there reached runs along the strike of these rocks. The contact with the Huronian occurs on a narrow strait leading northward to another arm of this lake, and its occurrence was indicated in advance by the presence, in the gneiss, of an increasing number of dark patches, apparently inclusions.

The attitude of the beds is somewhat similar, the schists first found dipping north 45°, while the gneisses near the contact are very nearly in the same position.

Along the eastern extension of this lake the rocks are principally green and massive, but in places rendered schistose by pressure and then frequently splitting into thin plates. Near the eastern end, seams of white calcite are found generally interlaminated with the beds, but sometimes breaking through them and holding fragments from the sides. The massive green rocks often show small blots and lenticular patches of easily weathered material, which leaves cavities on the surface. On the portage to Woman lake, the rock has the appearance of having been very much shattered and subsequently squeezed into schists along the lines of fracture.

On the first Clearwater lake, the rocks near the north end are massive green diorites, but toward the south they become more schistose and the bedding or cleavage runs south-west parallel to the general direction of that on Woman lake. Very fine grained, gray-green, massive looking porcelaneous rock, breaking with conchoidal fracture, is found on the last portage leading to the second Clearwater lake. This was not seen in contact with the rest of the series, but is probably one of the eruptives found in the Huronian. At the south end of the lake, a light yellowish-green, squeezed quartz-porphyry occurs, which is very similar to the beds at the north end of Woman lake.

The course of the river, through the string of lakes, has been somewhat parallel to the strike or bedding, but from Clearwater lake eastward, for two miles, it cuts across this direction, and another series of long narrow lakes is drained. The first of these lies in a north-east and south-west direction, with a narrow bay extending two miles to the south and connecting by a small stream with another long narrow lake lying farther south. The rocks here are rather fine-grained greenstones, with a fine porcelaneous surface of fracture.

At the portage to Fly lake, a light-green rock, evenly spotted with ash-coloured irregular markings on the weathered surface, is found. It is uniformly dark-green on fresh fracture, a coarsely crystalline hornblende-rock in which the bedding could not be made out.

Fly lake lies in the same trough as the lake north of it, and runs nearly north-and-south, the strike of the rocks following nearly the direction of the shores. At the north end, a dark-green massive rock prevails. Toward the south end, fine-grained bedded rocks which have the appearance of being altered sedimentary materials are first met with.

The strike of the beds is to the south, but near the south end of Fly lake this turns south-south-west, and on the Wenassaga river to the east, varies from south-south-west to south-west.

On the portage eastward from Fly lake, light-green quartzose beds are followed by coarsely crystalline hornblende rock. Down the stream, dark hornblende schists are seen on the side of the valley, and on the long portage to Wapagase lake, several ridges of the same dark-green coarse hornblende-rock are crossed, while at the eastern end, near the lake, schists are found which are apparently of the same composition, but show a secondary crystallization of the hornblende, a common contact phenomenon.

A few exposures of a thin bedded quartzite or quartzose schist are to be found at the small rapids below, all striking south-west to west-south-west, and at the little lake near the mouth of Sand-bar lake, gray gneisses, which possibly belong to the Laurentian, occur. The junction between the two formations was not seen, and the exact southern boundary of the Huronian was therefore not established.

The western outline of the area of Huronian rocks above described is probably very sinuous, beginning to the west of Shaboomene lake, making a long point toward Trout lake and taking in part of a long narrow lake, then forming a long tapering arm including Woman lake and touching the eastern end of Little Trout lake, with a very uncertain southern edge, reaching to near the Sand-bar river branch of the Wenassaga river.

Rocks of the Red Lake Area

The Huronian area of Red lake and vicinity is, on account of the greater variety of rocks included by it, of more interest than those previously described. The exact boundaries of its rocks are determined only by those exposures of contacts which are to be seen on the lake shore and on the streams explored, so that the connecting lines between such exposures are necessarily somewhat uncertain. The northern side of the lake touches the Laurentian only on Pipestone bay, and on Whitefish Spawning river the contact is a short distance from the lake, The boundary is thus conjectural between these points. To the south, the boundary is seen at several places on the lake, as appears by the map appended. There two large oval areas of granite come up through the Huronian rocks, and these granites, by the nature of the contact, are evidently intrusions. The complete section was not worked out, owing to lack of time.

The western bay of the lake, Pipestone bay, affords the best opportunity of studying an almost continuous exposure of the beds across the strike. It was found to present, with Trout bay to the south, a series of highly inclined beds representing possibly many folds which have assumed the general form of an anticline, the axis running east-and-west occupying the area of Pipestone bay. The beds on the north, in contact with the gneiss, dip northward at angles varying from 60° to 80°. At the centre and near the south side they are nearly vertical. Southward through the narrows, the inclination is south, varying from 50° to 80° from the horizontal. A synclinal fold with its axis running north-west, brings the beds up again on the south shore of Trout bay, where they strike along the general direction of the south shore of this arm. The continuation of this to the south-east probably forms a narrow belt, passing near Medicine Stone lake and joining the same rocks at Gull Rock lake.

The composition of the series in these folds appears to be as follows, in ascending order:—

1. Dark green schists, probably squeezed volcanic material, together with a more crystalline hornblende-rock which appears to be eruptive.

2. Yellowish-white, rusty-weathering, dolomitic limestone holding irregular nodules of a cherty nature. These beds in some places are more or less quartzose owing to the greater or less prevalence of the cherty masses. Alternating with them are greenstones which are occasionally altered to a soft chlorite or pot-stone, the pipe-stone of the Indians. In this form, an example is found in the narrows leading to Pipestone bay, where a bed of one foot in thickness lies between beds of rusty dolomite.

3. Beds of slate and schist, mostly black and dark-green, are found to intervene between the first rusty beds and a second series above.

4. The second series of rusty-weathering dolomites is preceded by a bed of squeezed and altered quartz-porphyry of ten feet in thickness. The dolomite is in a thicker bed, and, like the first, very much spotted with dark-weathering irregular masses of cherty quartzose material.

Above this is another band of altered quartz-porphyry, which is in the form of a gray hornstone with numerous blebs of quartz.

In other parts of the section, these beds can be with difficulty followed, but may become altered to varieties of slates, schists and quartzites, while layers of greenstone, perhaps of volcanic origin, are found interstratified or forming lenticular masses between the beds, often seemingly occupying the place of other members of the section.

The beds crossing the central portion of Pipestone bay, possibly representing the lower members of the series, are nearly altogether of alternate layers of greenstone and green schists, often becoming chlorite schist. Succeeding them to the north, a series of highly quartzose felsites, occupying probably a similar position to the lower dolomites of the south side, weather to light colours and assume the appearance of quartzites.

In the northward extension, which should represent the upper part of the section, the first band of altered quartz-porphyries and cherty dolomites only is found in contact with a band of dark diorites and hornblende-rocks, which extends to the contact with the Laurentian.

In a bay just north of the Wolf narrows, a band having the appearance of a conglomerate is found, with occasional pebbles of red banded jasper and others of a light-yellowish quartzite, but the majority of the pebbles are of a dark purplish-gray to green with a matrix of the same colour. The thickness of the band is about ten feet, and the associated rock is of a greenish to gray colour in rather thin beds. The position of this bed is probably represented by a band of conglomerate which follows north of the slates

Red and Trout Lakes Area (See map page 34 for geological legend.)

exposed on the north side of Slate bay. These slates, a fine-grained argillite in composition, are generally black and thin bedded, with many jointage planes dividing them into small pieces less than a foot in length.

At the eastern end of the lake, dark blue limestones are found associated with these beds, but as the strata there are apparently much folded, the relations of the two classes of rock could not be ascertained.

The rocks on the south shore of Granite bay, as well as the points on the north, are all of a light reddish granite in which the foliation is very slight. Wherever noted, this is nearly parallel to the general line of the northern border, dipping towards it at a low angle.

The line of contact of the Huronian schists is seen in many places, beginning on the west at the narrows from Trout bay, where it cuts off two small islands lying in front of the opening. Thence it crosses Marble bay, and the beds on the point to the east are cut at an angle of 45° by the granite, which occupies the point and also the western face of a small round island where the schists abut directly on it. The large island to the south is mainly granite, with only the slender point at the east end of Huronian. At the Wolf narrows, both shores are granite, the line of contact following nearly the line of bedding of the schists, and cuts off the northern point. In the bay to the east, the granite has been eroded to the contact-line, and along the shore small patches of it are found clinging to the face of a high cliff, while seams of the same material occur, running north into the mass of the darker rocks. This shore is thus chiefly composed of Huronian rocks, but generally represented by a dark crystalline rock which looks somewhat like a diorite squeezed in some places to a crystalline schist.

The granite of the south shore is replaced at the Middle narrows by black schists and dark-green rocks which strike south-by-east, apparently the same beds which border the north shore of the bay to the east. The contact line bends around from the north shore, touching the islands, and strikes the south shore just south of the narrows. There the contact is a sharp line running with the strike, but having a few parallel dykes of granite, apparently filling breaks made along the bedding near the contact. A few scattered dark angular fragments are seen in the granite.

The rocks of Marble bay, on the north, are continuations of the altered quartz-porphyry and rusty cherty bed which is seen directly to the west. These are followed to the north-east by fine-grained light-green altered rocks and by a small area of white calcite with many dark irregular markings which are very similar to those in the yellow beds before mentioned. This area of white marble-like rock does not seem to form a well defined bed, but looks rather like an irregular mass. At the end of the bay, dark crystalline rock is seen, altered to a serpentine or something of that nature.

The eastern part of the lake is divided into two parts by a string of islands, with a large one, Mackenzie island, at the north end. The northern part forms a long narrow arm running to the north-east and is named Slate bay, from the many exposures of this rock running parallel to the north shore, and also exposed on the north shore of Mackenzie island. The slate band of the north shore is found to be flanked on both sides by agglomerate. That on the south side is a dark-green mass, in which large lumps of slightly harder rock are cemented together by material similar in colour, but weathering somewhat more readily. Fractures along the bedding show a very lumpy surface. This bed may prove to be of volcanic origin, and it was recognized in two places, on a point at the west end of the bay and on another opposite Mackenzie island.

On the northern edge of the slate band, a narrow strip of lighter coloured slate, holding lumps or grains of quartz, was found. The possibility that this is a much squeezed and altered quartz-porphyry, is suggested not only by its appearance, but from the position it seems to occupy in the section, where it is apparently a continuation of the bed seen on Marble bay. This is followed northward by a bed of argillaceous slate, making a total breadth for the slate bands of nearly a quarter of a mile.

A band of cherty rocks, holding pebbles of much the same nature, occurs at the north side of a bay near the west end, and again appears north of the slates, in a deep bay northward from the centre of Mackenzie island Still farther north, after passing some dykes of fine-grained diorite, similar pebbly rocks are cut by granite dykes, which are apparently offshoots from a mass that seems to compose the hills at a short distance north of this arm.

On the north end of Mackenzie island and on the mainland to the east, dark blue limestones are found associated with dark schists. These rocks strike to the south of east on Mackenzie island, but north-west this changes gradually, till in the narrows leading to Whitefish bay they are running north-east and parallel to those on the north side. They seem to form a broad curved band coming from East bay and abutting on the schists and slates of Slate bay. In the narrows above, the rocks are fine-grained, black schists, and in East bay the principal rock seems to be a dark-green schist,, which maintains a nearly uniform strike of south-east by south. On the west shore are dark greenish-blue limestones, followed by yellow rusty-weathering cherty dolomites or lime-

stones, which are probable continuations of some of the limestone beds of Mackenzie island. The attitude of these is generally vertical, but occasionally they dip to the west. On the eastern shore of East bay several large dyke-like masses of granite, generally light-gray, cut the beds, and probably indicate the proximity of the granite which occupies the shores of Trout lake to the east.

The northern point of Mackenzie island shows beds evidently very much disturbed. Their strikes converge on a point just west of the island, dipping on the north point at a high angle to the north, to the south of this point, towards the south, and lastly, along the western shore, they dip to the west, apparently passing under the slates exposed on the west side of the island. The position of the dark-blue limestones would appear to be lower in the series than the slates though as there is possibly a great dislocation as well as folding, this is uncertain.

The bay to the south, or near the outlet of the lakes, is found to have been eroded through the centre of an oval area of intrusive granite, which occupies a part of the south shore, several small islands in the middle, parts of islands near the outlet and the southern part of Mackenzie island. The contact with the Huronian ou all sides shows the intrusive nature of this granite mass.

The schists on the south strike approximately parallel to the contact, following around the granite, while on the east and north, the beds are more broken up and have been replaced by the granite. Part of the beds which pass to the south do not reappear on the west, and are evidently broken off. The main mass of the rocks of the south shore, west of the granite, are black hornblende-schists and eruptives, and these beds are seen again at the outlet and thence to Keg lake, but a series of fine-grained greenish-gray, thinly laminated, chloritic schists, with lenticular patches and thin partings of calcite, lie to the north. These end at the granite, appearing only on its eastern side.

Rocks of Keg Lake and Gull Rock Lake

On Keg lake, beside the dark schists, a very quartzose, fine-grained, black rock, holding crystals of quartz, is found at the outlet, followed by spotted green rocks, which may prove to be agglomerates. Near Gull Rock lake, after passing fine-grained green eruptives, we find dark green schists at the west side of the lake in a vertical attitude, striking about west-south-west. These beds occupy the eastern part of the narrow neck separating the two lakes, and probably cross in that direction to the west. A mass of granite is found on the extreme south-eastern end of this point. Farther north, beds, which are continuations of those on Keg lake and the river above, are seen crossing the lake, but possibly do not extend much farther. On the small lake to the northward of Gull Rock lake, a small portion only of the shore is of Huronian rock, as the main part to the north-east is of granite and gneiss.

The schists on the west shore near the outlet seem to be vertical, running north-and-south, while a short distance northward, they run east-south-east and west-north-west, showing a good deal of disturbance near their eastern contact with the granites.

On the islands in the southern part of Gull Rock lake, masses of dark schists are found everywhere in contact with the granite, and often completely surrounded, so that the contact line is nowhere definite. The exposures are small, but the larger pieces of bedded rock appear to preserve their strike, so that many are possibly beds separated by finger-like intrusions of the granite; but on nearly all the islands many fragments are found completely inclosed in the granite.

To the south-west, somewhat the same appearance is noticed, especially on the river coming from Bug lake. Fragments are there found in the granite, forming a belt of broken gneissic and granitic rocks, which borders the Huronian along nearly its whole southern and eastern limit.

Superficial Geology

The surfaces of the Archæan rocks in this area are all more or less rounded and sometimes polished by glacial action.

Striæ are not well preserved on the surface of granite and gneiss, but in sheltered spots, as under boulders, they can be made out. On the finer-grained rocks of the Huronian, the surface is generally highly polished and the striæ are more distinct. The general direction is 22° to 40° west of south. The variations are caused by deflections in the direction of valleys or depressions through which the ice flowed. On the higher ground, the direction is more uniform and averages S. 30° W.

The material left by the glacier is of two types, an unmodified till or boulder-clay, and a stratified or re-assorted deposit in the form of fine clay, silt, and stratified sands. The till is found rather sparingly spread over nearly the whole area, immediately on the surface of the harder rocks, and has been in turn covered, in some localities, by the stratified sands and silts. A high ridge of sand, boulders and well rounded gravel, is approximately the northern and eastern boundary of these silts.

This ridge, or series of ridges, as found bordering the south side of Trout lake, is

seen again south of Little Trout lake, and crosses the valley of Trout Lake river above the first rapid. Hills, which are supposed to be similar in character, are seen south of Sand-bar lake on the Wenassaga river, and it is believed that the ridge may extend eastward to the head of Lac Seul. Northward, its extension is uncertain, but the Indians report a continuation from west of Trout lake to Berens river at Mick-kai-ame fall, or just east of Sturgeon lake, where there is a ridge of sand and gravel with boulders crossing the valley.

The top of the ridge, south of Trout lake, is a series of closely placed narrow hills or parallel ridges, steep on the northern face and more gradually sloping to the south, averaging about 270 feet above Trout lake or 1,575 feet above the sea. The material seen on the northern slope is sand and gravel with rounded boulders. Several steps or terraces are also noted, but they continue but short distances, and from the lake no such continuous line can be traced. On the surface of the ridge, large boulders are found, the crest being well covered with them, but they occupy a narrow belt only, as the slope to the south, though less abrupt than to the north, commences immediately. The general appearance of the ridge is not that of an ordinary land moraine, but suggests a moraine or accumulation along the front of an ice-sheet terminating in water of considerable depth, in which the débris has been somewhat evenly distributed.

To the north of this ridge, in the Trout lake country, there is a light coating of sand and gravel, but a much greater number of boulders is seen on the surface than to the south. The same in a less degree is true of the region to the east. On Trout lake, the large island named Cat island is capped by, and appears to be mostly composed of sand and gravel similar to that of the big ridge, and is of about the same elevation. Other hills immediately north of the ridge may possibly be of the same nature.

South of the ridge, the boulder-clay is found in a great many places to be covered by stratified deposits, and a number of occurrences may be cited.

On Lac Seul, at the Hudson's Bay Company's post, terraces of sand show sections on the lake shore of twenty to thirty feet of clearly stratified beds with clay partings. In one instance, several feet in length of a thin bed is contorted, evidently from the pressure of a large mass of floating ice. The beds beneath and above are not so disturbed.

On the south shore, cliffs of sand, which reach a height of about eighty or one hundred feet, are apparently continuations of the terraces at the post, and are no doubt stratified likewise.

On Wenastegao lake, just north of the western end of Lac Seul, stratified beds of sand, fifteen to twenty feet thick, are seen on the eastern shore. The valley of the Mattawa is characterized by stratified material containing more clay or silt, but capped by sands at about the level of Lac Seul. Again, on the streams coming from the north, the country cut through is found to have a considerable depth of stratified deposits in the valleys, which, although partly river deposit, is nevertheless often spread over a wide plain, as at the east of Little Shoal lake, and then seems to be earlier than the present river-valley.

On Gull Rock lake, beds of sand averaging twenty feet are shown in cliffs on the south-west side, and similar deposits are also found in some parts of Red lake. To the south, on Long-legged lake, there is not apparently so much of this stratified material, but local examples of sand-banks are found on the English river below Mattawa.

It might seem probable that the high ridge to the north indicates the eastern limit of the great glacial Lake Agassiz, because of its great elevation and the undoubted lake-deposit on its western and southern front. There appears to be, however, no definite information that these deposits continue beyond the basin occupied by Lac Seul, Shallow lake, Gull Rock lake and Red lake, and they may thus indicate a lake of much smaller dimensions. At present, there seems no reason to suppose that the outlet of this basin through the valley of the English river, had ever been dammed up to a greater extent than eighty feet by morainic deposits, but a possible barrier might have been formed by the presence of two small confluent glaciers on the higher ground on either side.

Between the hills bordering the west shore of Shallow lake and the ridge running north-east from the northern end of the lake, there is a wide, low flat, through which the Red Lake river runs, but two rather prominent hills seem partially to bar the exit of this stream, and it finally reaches Shallow lake by making a detour to the east around them. They are seen to be narrow ridges lying about west-south-west and east-north-east, and from exposures on their slopes, are known to consist almost wholly of boulders and gravel, well polished and rounded. Their height above the surrounding low country was found to be about 170 feet. The crest of each is a narrow ridge sloping abruptly on each side. Large angular boulders of gneiss and granite are found on the southern slope. The northern is in the form of three or four narrow terrace-like steps, showing only the well-rounded gravel and boulders on faces of the steeper slopes. The origin of these hills is probably the same as that of the Trout lake ridge, except that the position and direction would appear to indicate that they are lateral moraines. Smaller ridges

of morainic material are crossed or cut through by the same stream a short distance to the north-west.

In the valley of the upper waters of Berens river, the mantle of drift is of a variable thickness. On the height-of-land on the south and east, there seems to be very little but loose boulders, with some sand and clay. Lower in the basin, there is more sand with the same abundance of boulders. In one place on the lower part of White river, dark clay was found lying immediately above the rock, with sand on the surface.

Glacial markings and polishing are here again everywhere noticeable, but on weathered surfaces not very distinct. The general direction of glaciation appears to have been from the north-west. At the south end of Pekangikum Lake the striæ run S. 36° W., but farther to the east on Fairy lake they run west, thus showing considerable local deflection.

At the first fall above Sturgeon lake, a ridge of sand and gravel seems to be cut by the river. High banks of sand and gravel are shown at the portage and a ridge is said to extend to the south a long distance. On the White river, about south-west from the above place, the stream cuts through a deposit of sand and boulders. No section was seen, but the bed of the stream contains an increased number of boulders.

The agricultural possibilities of this valley seem to be limited, and the areas suitable for cultivation are only to be found in isolated patches. These are principally in the neighbourhood of the larger lakes. The Indian reserves have been located with this end in view as they seem to cover about the best land seen. The soil is a light gray clay with a little vegetable mould, and the gardens made by the Indians produce potatoes of fair quality, the only vegetable grown.

In the southern part of the district, better land is found and in greater extent than in the Berens River valley. On Lac Seul, at the mission and trading post, there are several very good gardens in a flourishing condition, with all the ordinary vegetables growing very satisfactorily. The Indians appear to care little for any gardening except a very primitive attempt at raising potatoes.

Land suitable for gardening was seen at Mattawa, and indeed the best and largest extent for this purpose is to be found between Lac Seul and Shallow lake. The country is well covered by timber, but of small average growth. The sandy-tracts are generally wooded by Banksian pine, but in the river-valleys and on the heavier land, poplar, birch and spruce are abundant. White and red pine are found in small groves south of Lac Seul and are of good average size for timber. On the lake are scattered trees of both varieties. The northern limit of red pine extends to Red lake, where a few trees were observed. Cedar of inferior growth occurs in isolated localities and extends northwest to the height-of-land, but none was seen within the Berens river basin.

REPORT ON A

TRAVERSE THROUGH THE SOUTHERN PART OF THE NORTH-WEST TERRITORIES

FROM LAC SEUL TO CAT LAKE, IN 1902[14]

By Alfred W. G. Wilson

INTRODUCTORY

On May 24, 1902, I received instructions to make a reconnaissance traverse across the unexplored area, some 15,000 square miles in extent, lying to the north of Lac Seul and east of Trout lake in the North West Territories.

Owing to the unsettled weather and irregular character of the shore-lines of the water bodies the work was confined to the southern portion of this area, to the survey of Cat lake, and to a short traverse northward from the east end of Lac Seul intended to locate the belt of so-called Huronian rocks lying north of this lake.

Throughout the season the topographic portion of this work was undertaken by Mr. J. F. E. Johnston, C.E., of the office staff; while the writer had charge of the geologic work.

Reports on the areas adjoining this unexplored district have been made by Fawcett,[15] Bell,[16] Low,[17] and Dowling.[18]

Topography

According to recent investigation, the Archæan areas of Canada have probably never been completely submerged since early Cambrian time. The nature of the rocks and their geologic structures show that they must at one time have been buried below the surface; hence, it must be inferred that these areas have been subjected to degradation, and that a great volume of rock has been removed. Quite recently Schuchert has shown that in all likelihood the areas immediately to the south of James bay were submerged during the middle Palæozoic time; while those in the district of Keewatin and the adjacent regions have probably existed as land barriers since their pre-Cambrian emergence. The greater portion of the erosion in the central parts must have taken place before the Palæozoic submergence.

During the period of partial submergence processes of marine planation may have locally modified the surface previously formed under the operation of sub-aerial processes. Within comparatively recent geologic times the surface of the country has been greatly modified by processes of glacial erosion and deposition.

The surface, as seen to-day, is thus the product of the operation of two, or possibly three, imperfectly known geologic processes, sub-aerial degradation, marine planation, and glacial erosion.

A Modified Peneplain

It is probable that the first of these has played the most important part. Under normal conditions sub-aerial processes, acting through a long period of time, would produce smooth or gently undulating surfaces. To such surfaces produced by sub-aerial processes the name peneplain has been given.

On a peneplain, however, one would expect to find the larger streams wandering in broadly open valleys; there would be no lakes: and the soil cover would be composed of mantle rock of considerable depth, in situ, very fine in texture at the surface, and gradually changing in depth into unaltered rock. Normally, also, the surface would not be elevated very much above sea-level.

None of the Archæan areas of Canada exhibit all these features. In the remarkably even sky-lines we find evidence of the existence of a planation surface which truncates the structures of the metamorphosed rocks; but in other respects the features of the area are not those of a peneplain. There are numerous lakes, and irregular streams with frequent rapids; scarcely any residual soil is found in situ, though a

[14] This report, published in 1909, is known as No. 1006 of the publications of the Geological Survey of Canada. A preliminary or summary report is contained in Vol. XV., Part A., pages 203-208.

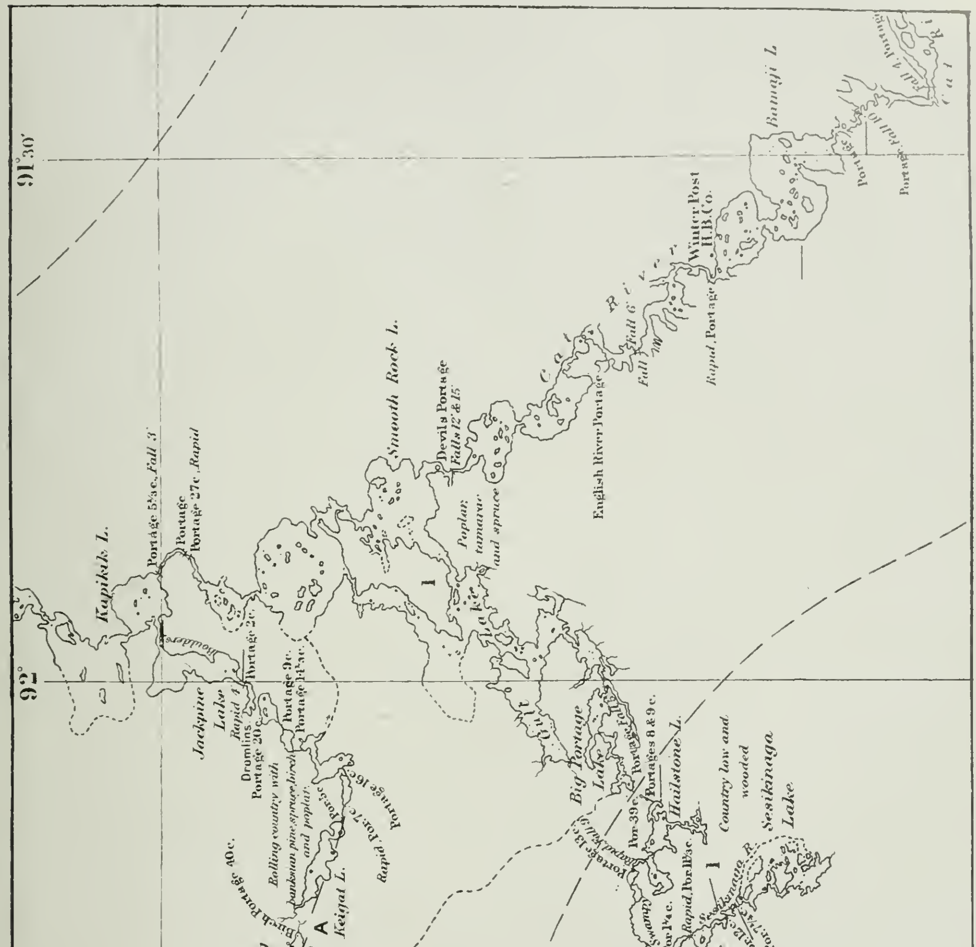
[15] Report of the Department of the Interior (Can.), 1885, pt. 2, p. 37 *et seq.*

[16] Ann. Report Geological Survey of Canada, 1886, Pt. G.

[17] Ann. Report Geological Survey of Canada, 1886, Pt. F.

[18] Ann. Report Geological Survey of Canada, 1894, Pt. F.

Cat Lake Area.



Wenasaga and Cat Rivers.

considerable amount of soil material has been deposited by glacial ice; and the central parts of the region stand high above sea-level. Yet it may be that this was once a peneplain area, and that its surface has been modified by other processes. Before or during the period when these other processes—chiefly glacial, possibly partly marine—were in operation, the region has been elevated to a considerable height. By their action the old soils were almost completely removed, new exotic material was deposited, parts of the old peneplain were dissected by the renewed activity of the rivers, and the present features were produced.

The modification has been sufficient to remove all traces of this original surface. This ancient peneplain, now modified, has been called the Laurentian Peneplain, and the present surface features exhibited by the Archæan areas may thus be spoken of as those of a modified peneplain.

The area through which the exploration lines of the present survey passed is near the centre of the Keewatin or western arm of this Laurentian Peneplain, which extends from Labrador around Hudson bay to the Arctic ocean north of the district of Mackenzie. The general topographic features of the region are those which everywhere characterize the Laurentian Peneplain. The rocks within its boundaries represent a portion of the earth's crust which at one time must have been far below the surface. Owing to its central location it might even be inferred that these rocks represent the deepest portion of the earth's crust with which we are ever likely to come in contact. A noticeable feature of nearly all the rocks of the area, especially of the granites and granitoid gneisses, is the presence of a relatively large amount of microcline and the absence of the other feldspars.

Lake Basins

Throughout this part of southern Keewatin, the various water bodies lie in shallow basins on the peneplain surface. The maximum relief in the interior, except in the case of a few monadnocks, is rarely over 50 feet; near the southern boundary it rises to about 200 feet. In a few places, ridges or isolated, dome-like masses rise something less than 100 feet above the general level. One of the most striking of these lies to the west of Cat lake, about 90 feet above lake level. Several other similar ridges were observed in the country to the south.

All the lakes studied were shallow, marshy, and very irregular in outline; some were surrounded by large areas of muskeg. The inter-stream areas are either bare rounded, or undulating surfaces of rock; or, are clothed, especially in the hollows, with a thin drift cover of sand, clay, and boulders, overgrown by a dense mat of moss (generally *Hypnum triquetrum*) and interlaced roots. As a rule the drainage is very imperfect. Occasionally there are small areas, underlain by a thicker cover of till or by a glacial sandplain, where the drainage is better and the moss cover is absent.

The Wenasaga river flows in a general southwesterly course, and it presents the usual characteristics of the streams flowing upon the uplands, viz., an alternation of long shallow flooded basins and short stretches of rapids.

The stream—particularly above Bluffy lake—flows in the lowest part of a drift-covered rock basin, through the deposits in which it has cut a well-defined channel sometimes to bed-rock.

Wenasaga lake, Bluffy lake, Slate lake, and the several minor lakes along the course of the stream are typical examples of the partly flooded upland basins. It is possible that in some of the basins the water is maintained at its present level, not only by the controlling rock ledge which outcrops at or near the outlet of each of the lakes, but also by a partial drift dam located over some lower portion of the margin of the rock basin.

The lake basins are generally rock-rimmed shallow depressions, studded with numerous islands, representing the unsubmerged portions of the ridges between the minor basins, and are a good index of the general character of all the other minor basins.

Islands

The form of the islands varies from that of a slightly rounded dome—characteristic chiefly of those which are composed of homogenous rock—to an arched dome with elliptical ground plan. The longer axis, except in a few cases where the islands are low and flat, lies in the direction of the strike of the rock. Even in these exceptions the longer axis of the island makes only a slight angle with the strike of the structure. In many cases the strike of the structure is approximately parallel to the direction of ice movement, and hence the form of the ridges sometimes seems to have also been a function of the direction of that movement. In many instances, however, where the structure of the rocks lies at an angle to the direction of ice motion as indicated by the striæ, the dominant factor in determining the form of the dome was not ice-scour but rock structure. Many of the ridges are of the typical roches moutonnées type with an ice-scoured surface, sloping gently in the direction from which the ice came,

and a steep, scarped face in the opposite direction. There are, however, numerous instances where steep, sometimes ice-scoured, cliffs face in the direction from which the ice came.

The basins are the counterparts of the ridges, and their form and direction bear the same intimate relation to the rock structure.

Owing to the partial submergence of some eskars, there are a few islands, particularly in Gull and Cat lakes—of a second type—to which reference will be made later on.

The intricate ramifications of the shore-lines, as shown in the accompanying map, are a necessary feature of the gently undulating topography characteristic of the whole region.

A number of minor streams, sometimes connected with chains of lakes similar to those through which our line passed, are tributary to the Wenasaga.

The amphitheatre-like basin drained by the Wenasaga consists of a number of minor basins, each with its quota of local basins having their own drainage systems which converge towards the meridian line of the main basin, and its discharge point near Lac Seul.

The Cat river—a river typical of the Laurentian Peneplain—flows southeasterly, and enters Lake St. Joseph about 20 miles from its western end. Northward as far as the line was run, it was found to be not a single stream but a long chain of lakes with short intervening stretches of river. In a few of these reaches the waters move with a steady flow in a well-defined, drift-filled valley, through which they have cut a distinct channel; for the most part, however, these stretches are rapid, broken, frequently braided, and usually occupy chance channels generally parallel to, but sometimes cutting across the ridges between the basins.

The lakes, on the other hand, contain numerous islands and have exceedingly intricate shore-lines. Numerous bays with narrow entrances and irregular back channels, running apparently in all directions, but actually directly associated with the rock structures, often make it very difficult for canoe travellers to find either inlet or outlet. The area of the marginal bays often greatly exceeds the area of the main portion of the lake itself.

Gull lake is an interesting example of one of these upland lakes. Fawcett's line traversed its eastern portion, and on his plan the south-east part appears as Smoothrock lake, and the northeast part as Gull lake.

Our exploration shows that the land to the northwest of these two divisions of what is really one large lake, is a large island, and that there are two other equally large water bodies, one to the northwest and the other to the southwest, each with an intricate shore-line and many islands.

The four water bodies, together with a number of ramifying bays, make a single large lake, in the centre of which is an island of nearly 20 square miles. The four divisions are connected by narrow channels in which there is only a perceptible current when the water is low; at such times the shallow channel between the two eastern portions of the lake may become almost dry.

Cat lake is an irregular body of water with a length of 14 miles between the inlet on the north, on the route to Severn lake, and the outlet to Cat river. Along a northeast-southwest line, to the ends of two long bays the distance is 18 miles. The lake, with its numerous islands and intricate shore-lines, is a typical example of the flooded upland areas. The ends of most of the bays are shallow marshy areas overgrown with reeds and sedges, the home of numerous waterfowl. The shores are rocky, and the ground is generally strewn with boulders and cobbles, the whole covered with a tangled mass of moss and roots, and overgrown with coniferous trees, usually black spruce, and occasionally poplar and white birch.

Small sandplains, generally well forested but with poor soil, are found around the shores and on a few of the islands. The Hudson's Bay Company's post at Cat lake is located on one of these. Most of the islands of Gull and Cat lakes are portions of Archæan ridges; a few of them are portions of eskars.

In Gull lake there are several islands which consist wholly of coarse cobble stones heaped in long narrow ridges trending northeast-southwest. These are completely bare of vegetation, rise not more than 6 feet above water level, and have a remarkable resemblance to artificial embankments.

Another well-defined eskar, of similar composition, but with a small amount of soil covered with spruce, forms a point which is nearly half a mile long and often less than 20 yards across. This point lies about 4 miles above the entrance to the lake on the direct route northward, and is known to the Indians as Peshe-asho-kummig, or Lynx bridge. It is much used as a causeway by moose and other animals crossing the lake.

Elevations

In the following table the approximate elevations above sea-level, of the larger lakes and of the divides crossed by the traverse line are given from barometric determinations. Dowling's determination of Lac Seul as 1,140 feet above sea-level was taken as the datum plane.

	Feet.
Wenasaga lake	1,172
Bluffy lake	1,240
Oganic	1,244
Slate	1,260
Margaret	1,300
Marsh	1,310
Hailstone	1,318
Height-of-land	1,325
Big Portage lake	1,270
Gull lake	1,263
Jackpine lake	1,278
Cat lake	1,285
Cross lake	1,225
Blackstone lake	1,204
Lake St. Joseph	1,200
Height-of-land	1,250

GENERAL GEOLOGY

The rocks of the region belong wholly to the Archæan; gneisses and schists predominate, granites occur, but are less widespread. The schistose structures are vertical or nearly so, and the prevailing strike is northeast, though there are minor local variations. Near Cat lake, and in a number of localities around Gull lake, the strike varies from N 38° W to N 80° W.

The oldest rocks are all metamorphosed, and are chiefly hornblende schists and amphibolites containing large amounts of hornblende, smaller quantities of quartz and a plagioclase feldspar closely related to oligoclase, and sometimes also a smaller amount of orthoclase. Several accessory minerals are frequently found, such as sphene, ilmenite or leucoxene, pyrite, and garnet. With the amphibolites are associated certain micaceous schists, but it has not yet been possible to define their areas.

Hornblende Schists and Amphibolites

All the hornblendes appear black in mass, and the amount varies from about 50 to 90 per cent. of the whole rock. In thin section the absorption colours vary from pale yellowish green to dark blue-green. The absorption scheme is c b a; the parallelism of the hornblende plates with the structure of the rocks is well developed. The relative amounts of quartz and feldspar vary considerably in different localities.

The quartz, when present, is almost invariably in small anhedra; the feldspars occur in larger anhedra, and are frequently altered to kaolin..

Biotite is found associated with the hornblende, but it generally forms only a small percentage of the minerals present. In this section the absorption colours vary from pale greyish-brown to deep brown.

Leucoxene, ilmenite associated with titanite in considerable amount, pyrite, and possibly a small amount of magnetite are also present. Near the southwest angle of Slate lake the compass was considerably affected by the local attraction.

Garnet, usually of a pale pink colour when in thin section, occurs in a number of localities in the amphibolite areas, both in symmetrical crystals and in strings and masses drawn out in a direction parallel to the foliation and filled with inclusions of the other constituents, usually quartz anhedra.

Occasionally small prismatic or radiating crystal-aggregates of a dark tourmaline, blue in basal sections, are found; less often the tourmaline has lost its crystal outlines and occurs in masses parallel with the foliation. The absorption colours in section are various tints of grey, except when the vibration plane of the nicol is transverse to the axis of the crystals, then the colour is black.

Other varieties of metamorphic rocks containing biotite, sericite, another mica seemingly related to the phlogopites, quartz, and other accessory minerals, but little or no hornblende, occur, sometimes with the amphibolites, sometimes apparently alone.

These amphibolites and associated schists occur both in belts extending for long distances, and as detached masses, varying in size from a few cubic yards upwards, and completely surrounded by the more acid rocks described below. Lack of time prevented a detailed examination of the contacts between the schists and the acid rocks,

but in the several localities noted the contacts were similar to those already fully described by Dr. Lawson as occurring in the Lake of the Woods region.[19]

The first and broadest of these bands begins about 21 miles above Lac Seul, and is about 25 miles in width. This is the belt of Keewatin rocks, shown on Dowling's map of the Red lake district.[20]

The contact between the schists and the acid rocks to the south seems to lie beneath a large muskeg area through which the river runs, as the first outcrop of the schists occurs some miles below Slate lake. The northern contact crosses the course of the river 10 miles above Slate lake, the basin of which lies almost wholly upon the schists; the direction both of the longer axis of the lake and of the longer axis of the island is parallel with the strike of the rocks outcropping on its shores. The adjacent rock on the northern boundary is a coarse pegmatitic granite containing inclusions of amphibolites similar to those of the main area. Detailed study of this area may show the schists to be divisible into several belts of different origin and composition, now all metamorphosed.

Along the southern portion of the band the schists, as already noted, are very rich in biotite and another associated mica; while northwards they are chiefly amphibolites, in some cases containing little else than hornblende. The other large belt of these rocks crossed in our traverse lies over 100 miles directly northeast of Slate lake along the Cat river route and north of Lake St. Joseph, in the vicinity of Blackstone lake, but its boundaries were not accurately determined.

There is at present no evidence that this belt bears any relation to the similar belts found farther west, though the relation of each to the adjacent acid rocks is similar. Between the northern boundaries of the schists on Slate lake, and the most northern point reached by our line, there are several narrow belts with amphibolites, rarely exceeding a quarter of a mile in width. Whether these are metamorphosed sediments or dikes is not at present determined. Probably both types are represented, except near Slate lake they never underlie dominant topographic features.

One of these belts, about 1½ miles wide, is crossed by the trail between Hailstone lake and Big Portage lake. The rock is a hornblende-plagioclase amphibolite carrying small amounts of biotite, garnet, sphene, ilmenite, and leucoxene. It strikes about N 80° W. and stands at a high angle.

Gneisses and Granites

The acid rocks of this region consist of gneisses and granites, and underlie most of the area under review. They range in colour from a light grey to a decided red, the prevailing tints being shades of pink. When the percentage of basic constituents becomes greater the colour is dark green or almost black.

Of the seven different varieties of Laurentian gneisses, as classified by Barlow,[21] only four are found in the area. The unrepresented gneisses are those in which muscovite occurs alone, those in which muscovite and biotite occur alone, and those which contain garnet. Several specimens showed augite as an accessory constituent, and one specimen contained biotite, hornblende, and augite.

These rocks differ in no essential feature from the typical rocks described by Barlow, and a detailed description of each type is, therefore, unnecessary.

Quartz is prevalent in all the gneisses, appearing invariably as irregular anhedra between the feldspar crystals.

Orthoclase often occurs in considerable amount, generally in irregular grains interlocking with the other minerals. Sometimes it has partly decomposed to kaolin or muscovite, and occasionally to zoisite or epidote.

In many specimens microcline is seen in large amount, and seems to be directly associated with orthoclase.

Plagioclase is abundant, and occasionally forms the bulk of the feldspathic constituents. The angles of extinction indicate that it is usually related to oligoclase.

The primary biotite, in a few cases partly chloritized, occurs both in large plates (in aggregates of several crystals) and in small isolated plates (generally oriented parallel to the rock structure).

When hornblende or muscovite is present the biotite is closely associated with it.

Hornblende occurs in a few specimens of these gneisses. In thin section the colours vary from pale yellow through green to bluish green, and are much lighter than the hornblende of the amphibolites.

Augite was found in two of the specimens collected in the field. In one it is unaltered, in the other much of it is altered to a hornblende which occurs both as small fibres or plates scattered through the mass of the augite crystals, and as large masses nearly surrounding them. The augite in thin section is pale green in colour.

[19] Lawson, A. C., Can. Geol. Survey Report, Vol. I (N.S.), 1885, Part CC, page 10 et seq.
[20] Dowling, D. B., Can. Geol. Survey Report, Vol. VII. (N.S.), 1894, Part F, map.
[21] Barlow, A. E., Can. Geol. Survey Report, Vol. X (N.S.), 1897, Part I, page 71.

Epidote is present, presumably as a primary constituent, since it is closely associated with unaltered biotite or hornblende. It is usually of a pale yellowish colour and slightly pleochroic.

Muscovite, both as a primary constituent and as a secondary constituent from the alteration of the feldspars, occurs; and a few specimens also contain chlorite.

Apatite is frequent in irregular grains and stout crystals.

Titanite is also found, usually in irregular grains of varying size or as small well-formed crystals.

Garnet appears in fresh irregular grains or masses, and as small crystals in specimens from the southern part of the region. It is usually much fractured and almost colourless.

Leucoxene is of frequent occurrence when titanite is present, and ilmenite is probably represented in these rocks by a black opaque mineral always associated with leucoxene.

Apart from structure there is little difference between the granites and the gneisses of the area. In some few cases the feldspar of the granites is almost wholly microcline. The prevalent granite is a hornblende-biotite granite, but there are other varieties sparingly distributed in which either or both of these constituents are lacking. In some localities there seems to be a gradual transition from true granites through granitoid gneisses to gneisses, and no definite line can be drawn between them. The granites frequently occur as large batholithic masses, dikes from which penetrate the surrounding rocks.

The largest single area of these gneisses and granites underlies all the country between Cat lake and Gull lake, and extends a considerable distance to the south and west. Just north of Slate lake our traverse line crossed a large area of coarse pegmatitic granite, which continues to Gull lake; other areas are found around Cat lake. The change in the strike of the gneiss at Cat lake, from the north-east direction found prevailing south of the lake to a north-west and nearly western direction, may be due to the intrusion of these granitic masses, though it has not been possible to work out the relations in detail.

Both gneisses and granites occur in the district immediately north of Lac Seul and Lake St. Joseph.

On an island in Lake St. Joseph, about 5 or 6 miles from the outlet of the Cat river, there is a belt of grey-white schistose rocks about 5 chains wide, strike N. 50° E. and dip at 79° toward the north-west. Microscopic examination shows that this is a highly altered quartzless porphyry, consisting mainly of sericite mica in which are altered phenocrysts of orthoclase and a small amount of less altered plagioclase, with, in one instance, a little apatite.

Glacial Debris

At many points along the route the bed-rock is obscured by loose debris of glacial origin. The greater part of this material, which presumably has not been carried very far, invariably consists of boulders and cobbles derived chiefly from the country rock. Along the rivers and in the lake basins this coarser material is frequently overlain by finer sands and gravels in the form of sandplains, generally small, but sometimes several square miles in area.

In a few cases along the Wenasaga river, on Cat lake, on the height-of-land between Lake St. Joseph and the Root river, and in an area north of the east end of Lac Seul, arenaceous clays, probably also of glacial origin, were observed.

Everywhere the hummocky ridges of the Archæan show the usual smooth rounded surface due to glacial action. Striæ and deeper grooves were noted in a number of localities. On the west arm of Gull lake small concentric cross-fractures were observed with the convex side turned toward the north-east so that a normal to the chord of the bow strikes S 54° E.

Near the east end of Cat lake a few flat plates of a sectile, finely crystalline, grey-white dolomitic limestone were found among the drift cobbles on the beach, and were recognized by our men as similar to rock they had previously seen in situ on the Severn river. The inference is that the fragments have been brought to Cat lake from the Palæozoic areas in the Hudson bay basin to the north-east.

The following table contains a record of the location and direction of the glacial striæ and grooves noted during the traverse. The bearings are magnetic.

Slate lake, island near middle	striæ	S 50° W
Slate lake, upper end	grooves	S 74° W
Near eighth portage	"	S 43° W
Marsh lake, north end	striæ	S 59° W
Gull lake, south end, concentric cross fractures (normal)		S 54° W
Gull lake, north end of south lake	groove	S 50° W

Gull lake, east lake, north side	"	S 48° W
Smoothrock lake, near inlet	striæ	S 52° W
Cat lake, northeast bay, north side, near Hudson's Bay post	striæ and grooves	S 74° W
Cat lake, northeast bay, middle of north side		S 75° W
Cat lake, northeast bay, island near east end		S 80° W
Cat lake, northeast bay, south side near middle, younger		S 87° W
Cat lake, northeast bay, south side near middle, older		S 72° W
Cat lake, northeast bay, south side		S 70° W
Cat lake, northeast bay, south side, opposite Hudson's Bay post		S 74° W
North bay, east side		S 72° W
Cat lake, north bay, on island in upper arm of lake about 3 miles northwest of the end of Fawcett's line		S 82° W
Cat lake, west side of main lake, west of Hudson's Bay post	striæ and grooves	S 74° W
Cat lake, west side of main lake, southwest of Hudson's Bay post		S 73° W
Cat lake, east side of main lake, point 2 miles below Hudson's Bay post		S 65° W
Smoothrock lake, southwest side above rapids	grooves	S 50° W
Lake St. Joseph, 2 miles south of Cat river	"	S 28° W
Lake St. Joseph, 2½ miles south of Cat river	"	S 38° W

ECONOMIC GEOLOGY

There seems to be little prospect of finding valuable economic minerals in the region in paying quantities. In almost all the bands of basic schists small, less often large, veins of quartz occur. At the surface these veins and the associated schists present the usual rusty appearance due to the decomposition of the pyrite. The granites are occasionally cut by pegmatitic dikes. Near the head of Cross lake, a rock, apparently of this character, carries a small amount of molybdenite in crystals varying in size up to an inch and a half across; it is uncertain whether the mineral is of economic importance, but the small size and the poor character of the specimen seen, and the difficulties of transportation point to the deposit being economically unworkable. The extent of the vein is not known. The property is at present (1902) in the hands of Mr. C. W. Ross, of Dinorwic, to whom the writer is indebted for specimens of the minerals.

Near the inlet into Slate lake, about three-quarters of a mile from its northeast end, on the eastern shore, is the only place where magnetic minerals were found sufficiently segregated to produce a noticeable local variation of the compass. Here, stringers of a metallic mineral, probably magnetite, were found. Though this metal is sometimes a constituent of the basic rocks, the more common occurrence of iron ore is in the form of ilmenite. No hematite was noted in the district.

BOTANICAL NOTES

The following notes, while not exhaustive, give a fair index of the phanerogamic plants of the area. The forest growth is found chiefly around the lakes and streams. The sands, sandy gravels, or clays, usually of glacial origin, are generally forested, the trees varying with the character of the soil. There are large areas of nearly bare rock where only a few stunted conifers or poplars grow in the crevices. Where the soil is sparse, and the country low-lying but yet fairly well drained, there is an open forest, chiefly black spruce, and the ground is covered with a dense mat of moss interlaced with fibrous roots. The soil covered, and the swampy areas, are usually thickly overgrown with small shrubs, mostly alder.

In general the timber is rather small; in most parts of the district at present too small even for pulpwood or ties. Occasionally along streams the trees are larger, especially north of the east end of Lac Seul. Another area of good timber, chiefly black spruce and tamarack, occurs along the Root river between Lac Seul and Lake St. Joseph.

Forest fires have swept over the region, probably on the average once every 35 or 40 years. On the islands and in certain protected localities one frequently finds fairly large trees, and there is, therefore, no reason to attribute the small size of the majority of the trees wholly to adverse climatic conditions. Around Lake St. Joseph an unknown extent of forest has been fire-swept, and in many places completely destroyed within a few years. North of Slate lake, around Big Portage and Gull lakes and northward, large areas have recently been burned.

The commonest and most widespread tree is the black spruce, *Picea nigra*. Associated with this, but in very much smaller numbers, is the Canada balsam, *Abies balsamea*. In the muskeg area the tamarack, *Larix Americana*, is found abundantly, rarely more than 8 inches in diameter. Many of larger size are found along the Root river. The only specimens of the red pine, *Pinus resinosa*, observed were isolated trees near the east end of Lac Seul; probably there are others in the district, but no important areas

are likely to occur north of Lac Seul or Lake St. Joseph. The Banksian pine, *Pinus banksiana*, however, occurs wherever the soil is suitable. The white cedar, *Thuja occidentalis*, is found occasionally along the Wenasaga river and on the Cat Lake route.

A few specimens of a species of maple were noted around Lac Seul and north of it. The canoe birch, *Betula papyrifera*, occurs sparingly throughout the whole region. Specimens large enough to afford bark for small canoes are found on the islands in Cat lake. Associated with this birch, but more abundant, are the balsam poplar, *Populus balsamifera*, and the aspen poplar, *Populus tremuloides*. Isolated specimens of the black ash, *Fraxinus sambucifolia*, were noted in several localities, even as far north as Cat lake.

REPORT ON

AN EXPLORATION OF PORTIONS OF THE

ATTAWAPISKAT AND ALBANY RIVERS

LONELY LAKE TO JAMES BAY[21]

By Robert Bell

Routes Followed[22]

Before entering into details of my exploration and its results, the description will be rendered clearer by the following short sketch of the routes followed throughout the season. From Wabigoon, a general north-easterly course was followed, via Lake Minnietakie and Lake St. Joseph, the Albany and Attawapishkat[22a] rivers, to James' bay. The water-shed between the rivers just named was crossed from the highest of the chain of lakes on the Eabamet branch, by which we left the Albany at about 90 miles in a straight line below the outlet of Lake St. Joseph. On crossing the height of land we struck the headwaters of a branch of the Attawapishkat, having a north-easterly course. This we followed with much difficulty to its junction with the main river, a distance of about thirty miles.

Soon after passing the height of land, I decided to send back Messrs. MacMillan and Murray with two of the men from Sault Ste. Marie to make a geological exploration of the route from Lake St. Joseph to Cat Lake and thence by Goose river to the west end of Lonely lake. They explored about two-thirds of Cat river and returned via Lake St. Joseph and the route by which we had entered it.

On arriving at the Attawapishkat river with my four men, I left the bulk of our stores in charge of one of them, and proceeded with the others to explore the river towards its source. Returning to this camp after a few days, we next descended the river to the sea, making a careful track-survey of it, taking numerous latitudes all the way to its mouth, a distance by the general course of the river of about 300 miles. We then coasted in our canoes to the mouth of the Albany river. A detailed track-survey of this large stream was made from James' bay to "The Forks," or the junction of the Kenogami, above which point I had surveyed both branches instrumentally in 1871. The Kenogami was ascended to Long Lake, from which, passing over the Lake Superior height-of-land, we descended the Black River to its intersection with the Canadian Pacific railway. As I was obliged to convey my men home to Sault Ste. Marie, the most direct route for doing so was by way of Port Arthur, which we reached on the 13th of October.

The different parts of the route above indicated will now be described with more particular reference to their geological features, but at the same time the geographical peculiarities, the aspect of each section, the timber, soil, climate, etc., will also be noticed.

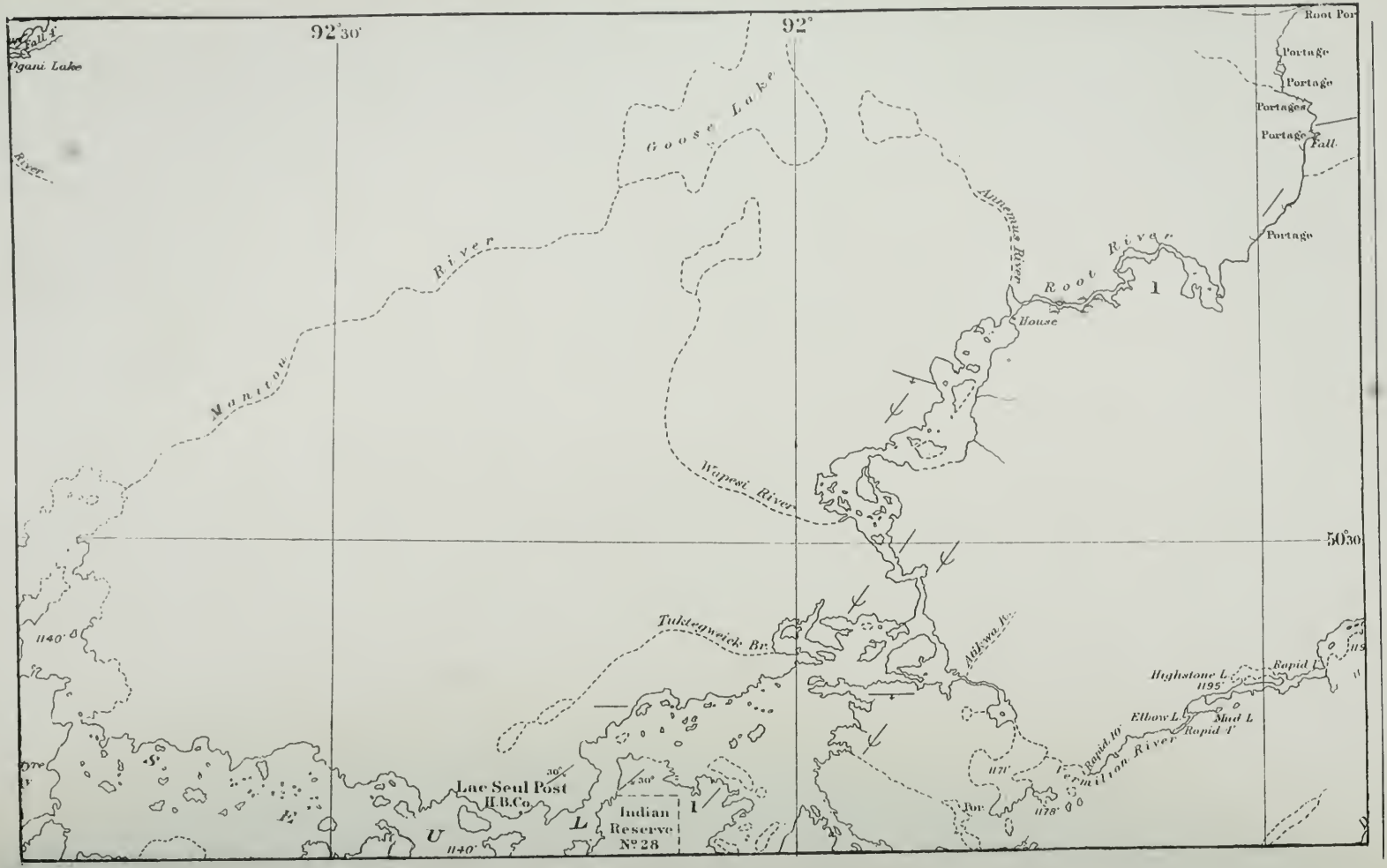
Pelican River and Lonely Lake

As the geology of the route between Wabigoon and Lonely Lake Post, via Frenchman's Head or "Lost Lake," was examined and reported upon in 1872, on this occasion, in order to explore new ground, I followed the main Pelican river from the point at which it turns off at right angles from Frenchman's Head channel between Pelican lake and Frenchman's Head lake, and flows north-norteastward into Lonely lake. The Indians informed me that the outlet of Sturgeon lake, which supplies a large part of the water of Pelican river, enters the north-east bay of Abram's lake, and we ascertained in 1872 that the stream which we then descended, called Sturgeon Lake river, and which enters the eastern part of Minnietakie lake, does not flow out of Sturgeon lake at all. At a distance of six miles, in a straight line, from the above point of divergence from Frenchman's Head channel, we came to the level of Lonely lake at the foot of a slight rapid,

[21] The exploration on which this report is based was made in 1886. The report forms Part G of Vol. II. of the Geological Survey of Canada. The preliminary or summary report on the exploration is to be found on pages 23-26, Part A, of the same volume. Lonely Lake is known more commonly as Lac Seul.

[22] This report describes the Albany river, on the inward trip, from the eastern end of Lac Seul, or Lonely lake, through Lake St. Joseph, to the Eabamet lake branch, about 90 miles in a straight line below Lake St. Joseph. On the outward trip the Albany was followed from its mouth to the Forks or the junction of the Kenogami river. The intervening part of the river, or that between Eabamet lake and the junction of the Kenogami with the Albany, is described on other pages in this volume.

[22a] The spelling is now Attawapiskat.



Lac Seul, or Lonely Lake, and Root River.

down which we ran our loaded canoes without difficulty. The eastern part of Lonely lake spreads itself in straggling channels and bays over a much wider area than has hitherto been represented on the sketch-maps of the region.

The Huronian rocks are everywhere met with from Wabigoon to the south side of Pelican lake, where they gave place to Laurentian gneiss. Near the junction with the latter, the Huronian schists run about west with a straight course, and the distinct banded structure which here characterizes them is nearly vertical. Both Abram's and Pelican lakes are traversed by partially submerged ridges of boulders, having the same south-westerly course as the glacial striæ.

[Most of the rocks classed as Huronian is this report should, under the nomenclature now in use, be called Keewatin.—W. G. M.]

Along the Pelican river, the rocks consist of grey, banded gneiss, of which the strike is for the most part between east and north-east and the lamination is on edge. Gneiss, of common red and grey varieties, continued all along our course through Lonely lake to its eastern extremity, but a marked change was noticed in the strike in the narrow north-westward "jog," where its course was about north with a dip to the east of from 10° to 50°. About the middle of this section of the lake, the gneiss is much broken and mixed with grauite. The shores of the eastern part of the lake are mostly marshy, but at the eastern extremity, massive gneiss is seen, and at a point on the north-west side, two miles from the extremity, the strike of a similar variety was observed to be north-west. It may be here incidentally remarked that gneiss with a little granite and a few trap dykes are the only rocks which have been observed on any part of this sheet of water, which is nearly 100 miles in length.

Pelican river is the largest feeder of Lonely lake, and as its waters are tolerably clear, they impart the same character to the lake west of its mouth, but to the eastward the water of the lake acquires the brownish colour of Root river, which empties into its eastern extremity.

Root River

The general upward course of Root river, which is followed in going from Lonely lake to Lake St. Joseph, has a north-easterly bearing, but the stream is very crooked, and it curves considerably to the south-eastward of a straight line. We followed this river to a point eighteen miles in a direct course from its mouth. Here the main stream bends off to the west, and we turned up a small branch from the north-north-east, which having no other name, we called Pond Lily brook, and at the end of three and a half miles, in a straight line, came to the height-of-land portage, half a mile long, leading over to the western extremity of Lake St. Joseph. The lower half of the eighteen miles of Root river, which we followed, is a sluggish stream, expanding in several places into small lakes with wide marshy borders. On the above route, massive gneiss is exposed in many places all the way from the east end of Lonely lake to the west end of Lake St. Joseph. On the top of the nearly bare hills of gneiss, on the west side of Pond Lily brook, half-way between its junction with Root river and the height-of-land portage, some angular fragments of fine-grained siliceous magnetite were found. The height-of-land portage, which rises only a few feet above the level of Lake St. Joseph, passes over bouldery and clayey ground, with a bog in the middle.

Lake St. Joseph

In 1885, Mr. Thomas Fawcett, D.L.S., measured a zig-zag line through Lake St. Joseph by means of the Lugeol micrometer, the angles being taken with the transit. In constructing the accompanying map, his distances have been adopted, while the details are taken from my own sketching, based on a track-survey made by a floating boat-log and careful timing of the speed of my canoe, all bearings being taken by a good compass.

The mean of ten barometric observations, noted on as many different days, on Lake St. Joseph, give its elevation as 1,172 feet above the sea. Its general course is east-north-east, true, and its length from the western extremity to the northern of its two outlets at its opposite end, is fifty-eight miles, and to the more southern outlet fifty-five miles. The breadth varies from a quarter of a mile to three miles, with an extreme width of eight, measuring across points, but the average would be about one mile and a half. It may, therefore, be described as a narrow, straggling sheet of water of the above dimensions, the area of its water surface being much reduced by the points and peninsulas and the great number of islands of all sizes, from three miles in length downward, which it contains. The largest space of open water is the Grand Traverse, at about two-thirds of the distance from the west end, which is three miles wide and measures eleven miles from south-west to north-east.

The country around Lake St. Joseph may, in a general way, be said to be level, although some low rocky hills are to be seen in places. Ridges of granite, nearly destitute of timber, occur around the western mouth of Cat river, not far from the west

end of the lake. To the eastward of the first narrows, east of the eastern mouth of this river, rounded hills of gneiss may be seen on both sides; and again on the west side of a northern arm, fifty miles from the west end. In the narrow section towards the east end, which has a general south-east course, but in which all the points and bays run north-east and south-west, a few low ridges of gneiss run parallel with these, and some long rows of boulders or moraines, rising just out of the shallow water, have the same direction. It will be observed that while the general course of the lake is about east-north-east, the bays and points run more nearly north-east and south-west. A table of the directions of the glacial striæ is given further on, from which their average bearing will be seen to be south-west, thus corresponding with the general trend of the depressions in the face of the country. At the "Fall Fishery Station," forty-four miles from the west end, the surface of the quartzose gneiss, which occurs there, is thoroughly planed off, and along with the striæ, running S. 30° W., the bruised crescent-shaped marks, indicating great pressure, may be seen following each other in rows, their concavities looking south-westward, showing that the glacial movement was in that direction.

It would be difficult to estimate the proportion of cultivable soil compared with the worthless area in the country adjacent to the shores of Lake St. Joseph, but the percentage does not appear to be great. In some places, both on the main shores and the larger islands, low banks of sand and of yellowish loam were seen, but, as a rule, the surface appears to be either too stony or too level and wet to give much promise as a farming region. The Indian name of Lake St. Joseph is "the lake of the swampy country."

The climate in the immediate vicinity of the lake, at all events, appears to be sufficiently good to admit of the growth of a variety of crops. At Osnaburgh House, near the east end, where the soil is of a sandy nature, the principal crop cultivated at present is potatoes, but early Indian corn, peas, beans, and a variety of roots and other vegetables, to say nothing of a profusion of flowers, were in a flourishing condition in the end of July. In former years, when cattle were kept at the post, barley was said to have been a regular crop. Hay grows very luxuriantly. I was credibly informed that pumpkins and muskmelons had frequently ripened at this establishment.

The timber all around Lake St. Joseph has suffered greatly from forest fires at many different times from about a century ago to the present year. Parts of the main shores and many of the islands, especially in the neighbourhood of the Grand Traverse, have escaped the fires, and here full-sized timber may be seen. The second growth woods are of all ages, from seedlings of a year or two, up to trees nearly as large as those of the original forests. As elsewhere in these latitudes, where the old forests of spruce, tamarac, balsam, white birch, etc., have been burnt, they are succeeded by a growth of mixed aspens and white birch, with a sprinkling of spruce, or else by one consisting almost entirely of Banksian pine. In regard to relative abundance, the trees found around the lake may be mentioned in the following order:—white and black spruce, tamarac, aspen, white birch, Banksian pine, rough-barked poplar, balsam, white cedar, pigeon cherry, rowan and black ash. The ground or mountain maple (*Acer spicatum*), which is interesting as an indicator of climate, is common, and it was traced for a long distance down the Albany. Of the above kinds of timber, the white spruce and the tamarac are the most important commercially. The cedar is confined chiefly to the immediate shores of the lake, where it often forms a continuous but narrow border. It has the same habit around the other lakes and along the rivers in the whole of this part of the Dominion. But it is also frequently found in large patches in the inland swamps of these regions. About twenty spruce logs, for sawing into boards, were lying at Osnaburgh House at the time of our visit. They would average eighteen or twenty inches in diameter at the butts, the largest being about two feet. The six largest showed the following number of rings of growth:—113, 97, 121, 116, 107, and 120, or an average of 112, these rings indicating, it is supposed, a corresponding number of years. A new tamarac flag-staff, which was about to be erected, measured about eighteen inches in diameter at the butt and showed 244 rings of growth.

The number of Indians living around Lake St. Joseph is not very great. They live principally upon fish in the summer and rabbits in winter, but these resources are supplemented by geese and ducks in the spring and autumn, and occasionally by larger game, such as caribou and bears at any season. The fishes of the lake comprise white-fish, grey trout, sturgeon, pike, pickerel, yellow-barred perch, grey and red suckers, besides some smaller species.

Rocks of Lake St. Joseph

The rocks observed on the shores of Lake St. Joseph will now be described. Leaving the portage at the west end of the lake, massive grey gneiss, striking about east and west, occurs on both sides at between two and three miles, and again on the north side at four miles and a half, where it strikes S. 80° W. About a mile farther on the rock

has changed to a light pinkish-grey granite of medium texture, which consists principally of felspar and quartz, the mica being in very small quantity. This rock extends up the channel which forms the western mouth of Cat river, for at least four miles, but the channel was not explored any farther. Along the main channel of the lake, beginning at six miles from the extremity, a soft, glistening, green, calcareous schist flanks this granite on its south side. This schist continues for ten miles, with a strike varying from S. 60° W. to S. 70° W. A small island at eighteen miles, consists of coarse, massive grey silicious schist, striking west. Another small island, half a mile north of the last, is formed of massive dark greenish-grey dioritic schist. A similar schist, running N. 80° W., was found on another island two miles farther on, or about three miles east of the eastern mouth of Cat river. Half a mile east of the last-named island, a grey rusty-surfaced mica schist on a small island was found to run N. 60° W. At the western entrance of the narrows, twenty miles from the west end of the lake, green schists strike N. 50° W. The long island in these narrows consists of dioritic schist and conglomerate. An islet on the north side of the eastern entrance of these narrows, or about seven miles E. by S. of the eastern mouth of Cat river, consists of a massive coarse crystalline hornblende rock, becoming somewhat schistose on the south side. Its strike is east and west.

About a mile east of the last-mentioned islet both shores of the lake were found to consist of gneiss, so that the dividing line between the Huronian and Laurentian, which occurs in this interval, will be about twenty-four miles, in a straight line from the western extremity of the lake. Time did not permit of a fuller examination of the Huronian rocks of the western part of Lake St. Joseph, but the foregoing examples will serve to give an idea of their characters, which, it will be observed, are somewhat varied.

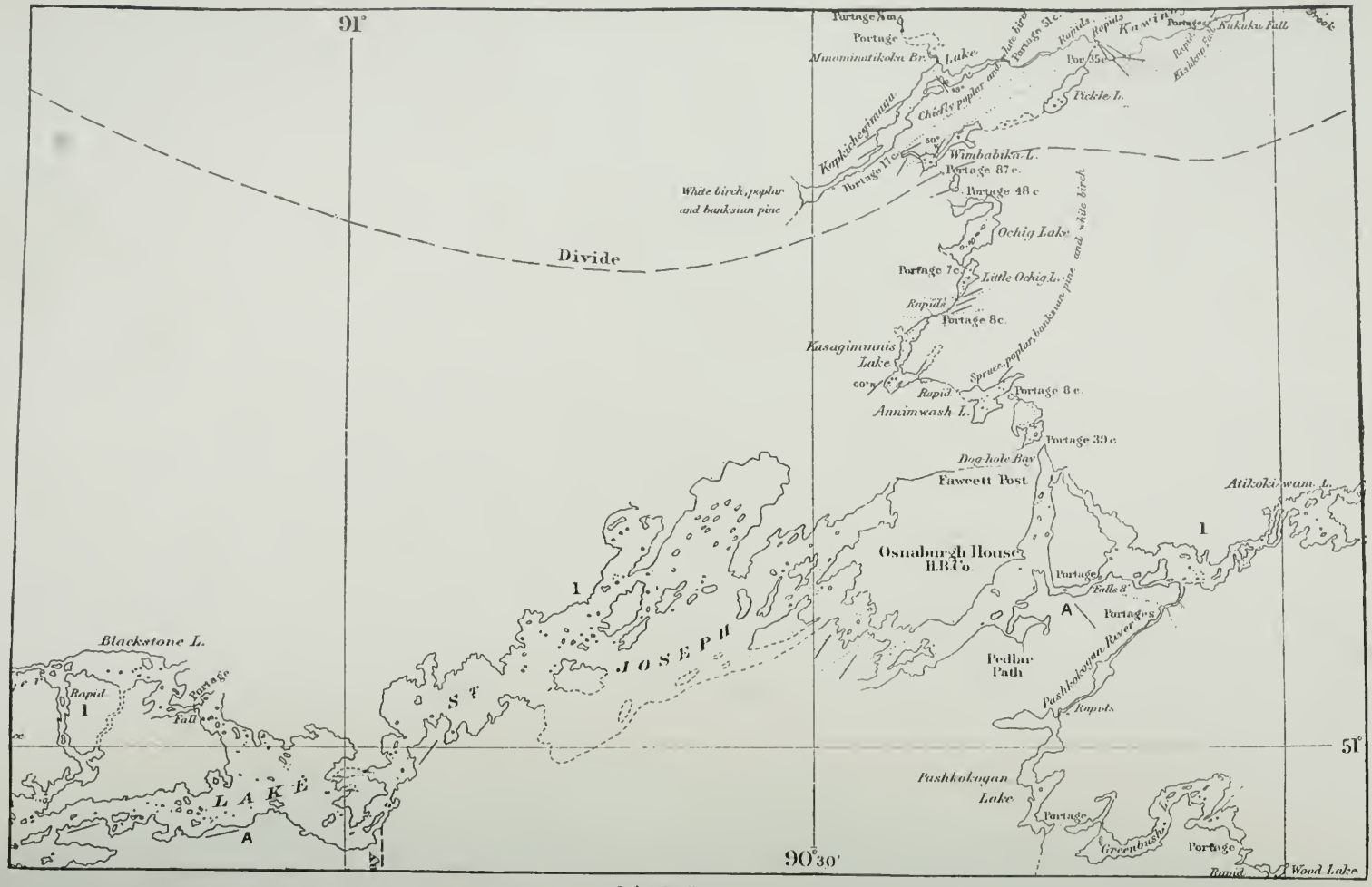
The gneiss near its contact with the Huronian schists, and for some distance onward, strikes east and west, or parallel with the latter. At thirty-eight miles from the western extremity of the lake a long bay runs off to the north-eastward. The gneiss in its vicinity is of a hornblendic character, and its strike is S. 45° W. On the northern shore of the lake, forty-four miles from the west end, is the fishing station, already mentioned, at which large quantities of white-fish are taken late in the autumn or just before the ice forms. At this place the rock consists of light grey gneiss. A northward arm of the lake runs for six miles beyond the fishery, and the massive light-coloured gneiss extends all the way to its extremity.

The rocks of the eastern part of the lake correspond with some of those of the Huronian series. On the northern side, at four miles from the southern outlet, or three miles from the Hudson's Bay Company's post called Osnaburgh House, which is situated opposite to this outlet, a grey mica-schist dips S. 60° E. angle 60°, or strikes 30° W. It is cut by a wide vein of coarse light-colored granite, in which a considerable proportion of mica is mixed with the felspar and quartz. Opposite to this point is the mouth of a small river, called the Pedlei's Path, which forms part of a route to Lake Nipigon. My assistant, Mr. Murray, ascended it for about six miles, in which distance he passed through three small lakes. He found the rock at the mouth to consist of rather fine-grained hornblendic schist, striking west. The long bay running northward from Osnaburgh House was examined by Messrs. Murray and MacMillan to the extremity, from which the northern outlet of the lake flows. They found the rocks along the western shore to consist of hornblende and mica-schists with some fine-grained gneiss, all striking about east and west, except at the northern extremity of the bay, where a fine-grained gneiss had a north-westerly strike. The schists are traversed in several places by large veins of coarse granite, which, having resisted denudation better than the surrounding rock, stand out as small points in the lake. On the east side of this bay gneiss was the only rock observed north of the southern outlet, where, however, a grey mica-schist, striking north-west, occurs along with light-coloured coarse granite.

This completes the description of the geology of Lake St. Joseph as far as I was able to investigate it in the limited time at my disposal. It will be observed that the prevailing rocks around it are gneisses, but that Huronian schists, etc., extend between seven and twenty-four miles from the west end, and are again developed around the eastern extremity; also that granite prevails about the western mouth of Cat river, and this rock will be shown to extend from near the southern outlet of the lake for a considerable distance down the Albany river.

Albany River—Upper Section

Leaving Lake St. Joseph by the southern outlet, at two miles down the Albany river, which takes its rise in this body of water, we came to Hugh's Creek portage, on the north side, 460 paces long, with a descent of ten feet in the river. The rock is here dark green, fissile, hornblende schist, strinking N. 65° W., nearly vertically. From the foot of this rapid an expansion of the river, called Deep-and-Shoal lake, extends north-westward to the rapids at the northern outlet of Lake St. Joseph. A river without any recognized name enters the Albany from the south, six miles below the southern outlet. Two miles below Hugh's Creek portage, a light pinkish grey granite makes its appear-



Lake St. Joseph.

ance on the points and continues for nine miles, or to the northern outlet of an expansion, three miles wide, called Atik-o-ki-wam or Deer Lodge lake, which has two discharges that unite again only nine miles further down. The Albany, with its lake-like expansions, from its head at Lake St. Joseph to Deer Lodge lake is shallow, and full of angular and rounded boulders of granite. The shores are mostly low and covered with brush and grass alternating with knobs of granite. The timber farther back was burnt two or three years ago. At the northern outlet of Deer Lodge lake, the rock is a somewhat coarsely crystalline diorite, having a bright fracture, the crystals of black hornblende and white felspar together, giving it a general dark grey colour. It probably belongs to a large dyke cutting the granite.

From Deer Lodge lake we followed the northern and larger channel, which is broken by numerous rapids. Portages are required at four of these, the first being the Smooth Stoney portage on the north side, at four miles, 715 paces long, with a fall of thirty-six feet. The others are called the three Kagami portages, and all occur in the last mile before arriving at the junction of the two channels.

The first Kagami portage, on the N. side, has a fall of five feet, and is 100 paces long.

The second Kagami portage, on the S. side, has a fall of 27 feet, and is 750 paces long.

The third Kagami portage, on the N. side, has a fall of eighteen feet, and is 570 paces long.

Between the diorite at the outlet of Deer Lodge lake and Smooth Stoney portage, granite occurs in several places. At one locality in this interval a granitoid rock showed traces of lamination, running north-easterly. At the portage just mentioned, a massive grey granitic gneiss strikes N. 30° E. At the first and second Kagami portages the rock consists of fine-grained reddish grey granite, in which quartz is the most and mica the least abundant constituent; while at the third of these portages it is a pinkish-grey gneiss striking N. 60° W., with vertical lamination. A great rapid or chute occurs in the southern channel from Deer Lodge lake where it falls into the other branch opposite to this portage.

From the foot of the long island just described, the general course of the river is north-eastward to the junction of the Etow-i-ma-mi river, from the northward, a distance of thirty miles. It is considerably broken by rapids, but we ran our loaded canoes down all except two of them, at which portages were required to be made. Gneiss, which was generally coarse, grey, and massive, was observed in several places in the above thirty miles, and wherever the lamination was apparent, the strike was to the northwestward. At a southward angle of the river, about eight miles above the Etow-i-ma-mi branch, the Mischkow river falls in from the south.

Magnetic Iron Ore

Below the Etow-i-ma-mi the Albany turns south-east for five miles, when it is joined by the Sha-bush-quaia river from the southward. At two and a half miles below the former branch, Huronian rocks make their appearance. They consist of light-greenish, rather finely crystalline hornblende schist, black, with some light coloured schist, together with fifteen or twenty feet of fine-grained banded magnetic iron ore with slaty partings. A specimen of this ore was analysed by Mr. Kenrick of the Geological Survey, and found to contain 42.09 per cent. of metallic iron, and to be free from titanic acid. Along with the magnetite is a band of iron pyrites, a few inches thick, with traces of copper. These rocks are so much disturbed that it is impossible to determine their strike. The joints in the hornblende schist are slickensided, and many of them are occupied by strings of calcspar.

A dark green hornblende schist occurs at two miles before coming to the Sha-bush-quai-a river, and strikes N.70° E., dip 90°. It holds patches of calcspar and quartz running with the cleavage.

The Eska-qua, or Green Bush Portage, being the 8th from Lake St. Joseph, is met with at a mile and a half below the Sha-bush-quai-a river. It is on the right or south side, and is 505 paces long. There is nearly perpendicular fall in the river of fifteen or twenty feet, and the total descent at the portage is about twenty-five feet. The rock is a soft, green schist, striking N. 85° W. with great regularity. Specks of copper pyrites were found in small quartz veins in the schist at the foot of the fall. A mile below this portage, similar schist and a hornblende rock, having a pitted weathered surface, strikes S. 80° W.

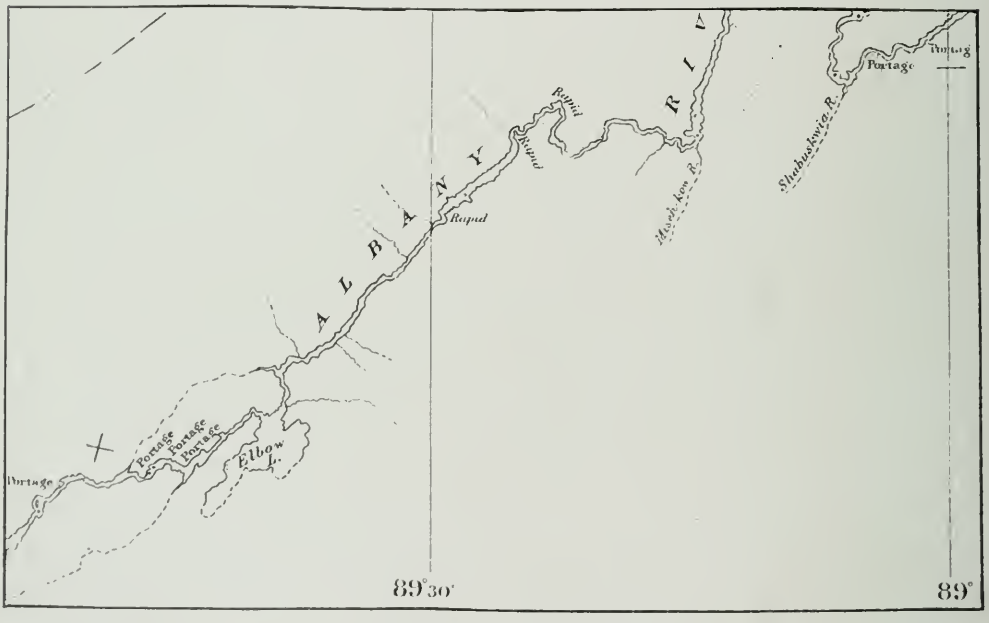
The Lower Eska-qua, or ninth portage, on the right side, and 185 paces long, with a descent of twenty-five feet, occurs at two miles below the last. Soft green schist with calcspar in the joints and cleavage planes is found here. One band shows a concretionary lenticular structure. The strike is S. 65° W., with a south-eastward dip of 75°.

The head of the tenth, or Snake portage (Kenaibik Inigum). on the left side, is a

mile and a half below the last. It is 480 paces long, and the descent in the river is ten feet or more. Soft, green schist, striking S. 75° W., is here largely exposed. Much of it has the concretionary structure so often observed in the Huronian schists. It is traversed by a band or dyke of coarse, grey felsite, from nine to thirteen feet wide, in which grains of blue quartz are thickly disseminated. Its general course crosses the cleavage of the schist, but it bends suddenly at an angle of 55°. Large glacial furrows, running in a south-westerly direction, occur at Snake portage. Between this portage and the inlet of Maminiska lake, four miles farther on, chloritic schists are exposed in two places, the strike ranging from S. 10° W. to S. 25° W., the bedding or cleavage being vertical.

Maminiska and Patawonga Lakes.

The country on either side of the Albany river, all the way from Lake St. Joseph to where the Huronian rocks commence, below the Etow-i-ma-mi branch, is generally level, few hills of any kind being seen. The shores of the river are rocky or bouldery, but the banks often show gravel, sand, loam and clay. But from the last-mentioned locality to Maminiska lake and to the south of this sheet of water, numerous earthy-



Elbow Lake, Albany River.

looking hills are visible. Wherever a view can be obtained over the country, long slopes of gentle undulations may be seen, the hill-sides being covered either with old timber or a second growth of aspen and white birch. Some small grey elm trees were observed at the inlet of Maminiska lake, being the first noticed since leaving Minnietakie lake, where a single small tree of this species was seen. A grove of black ash occurs with the elms, but this tree is not uncommon along the Upper Albany.

Maminiska lake runs north of east, and is about sixteen miles long. It is divided by a very narrow place, about half-way down, into two equal parts, each three miles wide. The rock at the narrows consists of a hard, close-grained diorite, of a somewhat concretionary character. An obscurely stratified appearance in it has a west-south-westerly bearing.

Cedar river enters the north side of the lower division of Maminiska lake. An Indian, whose hunting grounds surround Cedar lake, at the head of this river, described it as being about the size of the lower division of Maminiska lake, and containing many islands. It would appear to lie about thirteen miles north of the latter. He said there were six portages on Cedar river between the two lakes.

The outlet of Maminiska lake is on the south side of the eastern half, and, after a rapid descent southward of two miles, the river falls into the head of Patawonga lake.

The eleventh portage, 110 paces long, by which we got past a steep chute with a fall of eighteen feet, is on the left side, and about midway between the two lakes. The rock

at this chute is a coarse, grey stratified concretionary diorite, with spots of light-coloured felspar, and a smaller proportion of spots and patches of green epidote scattered irregularly through it. It strikes west, dipping southward at an angle of 60° to 70°, and contains a good many irregular veins of quartz, holding epidote and hornblende, the veins for the most part running with the stratification. A number of these veins, from three to fourteen inches thick, were carefully examined for metallic ores, but none could be detected.

Patawonga lake is about thirteen miles long, with a course bearing to the south of east, and varies from half a mile to two miles in width. It is surrounded by a level country. Two rivers flow into it from the south and one from the north. On the south side, near the outlet, schists, supposed to be Huronian, standing in a vertical attitude, strike east and west. An islet, about midway between the extremities, consists of a gneissoid rock, composed of quartz, hornblende, and a triclinic felspar, striking N. 75° W. Ordinary gneiss occurs on an island in the outlet.

Within the first two miles from the outlet of Patawonga lake there is a strong rapid, with a descent of from twenty to thirty feet, requiring a portage (the 12th) of a few hundred yards, but it varies in length according to the height of the water; and at three miles the river falls into Ka-wi-tos-kam-igamog lake. This is five miles long and has a north-easterly course. It is remarkable for having a straight ridge of drift which forms an island nearly two miles long, running down the midde of its lower part. The thirteenth portage, 290 paces long, crosses part of an island at one mile below the last lake, and the descent in the river is about twenty feet. Gneiss was observed in two places in the next two miles. At the end of this distance we entered a lake measuring about two miles along its north-west side, and which from its shape might be called, for convenience, Triangular lake.

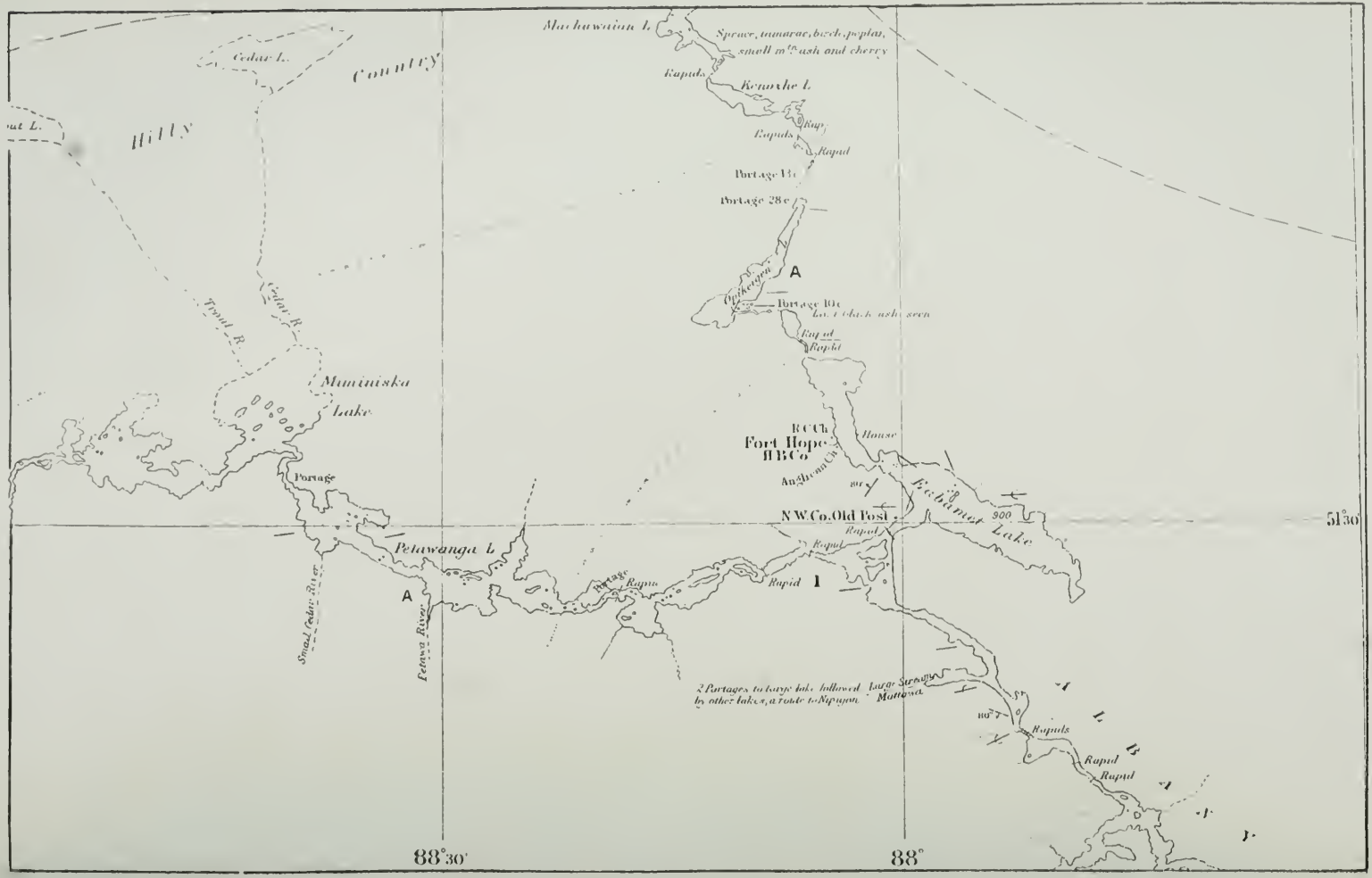
Eabamet River and Lake

The Eabamet river enters the north-eastern angle of this lake, while the downward continuation of the Albany flows out of its south-eastern corner. From the junction of the Etow-i-ma-mi, mentioned above, to this lake, a distance of upwards of forty miles, the general course of the Albany has been about east, but it now turns south-east. Triangular lake is within twenty miles of Abazotikitchewan lake, at which I struck the Albany in 1871 when making a micrometer survey of a canoe-route from Lake Nipigon. From this point, the survey of the river was then carried down-stream to The Forks, or junction of the Kenogami. In order to connect the upper part of the river with the survey, I sent Messrs. MacMillan and Murray to make a track-survey of the intervening link. They found the distance to be about twenty miles and the general course of the river south-east, as just stated, with only one rapid requiring a portage, between the points referred to. In this stretch, the river has the same general lake-like character which it has maintained from the head of Maminiska lake, a distance of twenty-six miles, and which continues to the foot of Makokibatan lake, about thirty-four miles below Abazotikitchewan lake, or for eighty miles in all.

Mr. MacMillan found gneiss here and there on the shores of the Albany for about half the distance from Triangular lake to Abazotikitchewan lake, but in the second part of the distance, hornblende schists, striking east and west, continued to the north side of the latter lake, where I had found similar rocks with granite and trap in 1871. Gneiss, with a west and north-west strike, was then described as occurring all around the southern part of the last mentioned lake. (Report of Progress for 1871, page 109.) The breadth of the hornblende schist belt is apparently between six and seven miles, at right angles to the strike, and it is perhaps connected with the Huronian belt which I found between Lake of the Narrows and Martin's Falls, and which appears to be folded and repeated to the north of the part of the Albany referred to. (Same report, page 110.)

Leaving the Albany and following up the lowest section or link in the Eabamet river, a small stream unbroken by rapids, we entered Eabamet lake, at a distance of only about one mile. This sheet of water runs east-south-east and is about eleven miles long by one mile and a half wide, and the stream by which we entered it flows out near the middle of the south-western side. In the vicinity of the outlet, micaceous gneiss dips S. 80° E., angle 45°. About a mile from the upper end of the lake, on the same side, ordinary grey gneiss strikes north-westward. On the north-east side, four miles from the upper extremity, a very micaceous grey gneiss, passing into mica-schist, strikes N. 60° W. and dips north-eastward at an angle of 70°. It is cut nearly at right angles to the strike by irregular dykes of a coarse, light grey granite, with branches following the lamination, holding considerable numbers of grains and small crystals of a green mineral, which Mr. Hoffmann finds to be apatite.

From the head of Eabamet lake the river is rapid and has an upward north-westerly course of three miles, with Round lake (one mile in diameter) half way, and we then



Eabamet Lake, Albany River.

enter Fishing lake. The rocks between these lakes consist of dark grey compact felsite in very even laminæ and green dioritic schists, interstratified with a grey gneissoid rock, containing a triclinic felspar. The strike is east and west. These rocks are classified with the Huronian.

Fishing lake runs north-north-east and is about eight miles long. No fixed rocks are seen on its shores. The rapid stream flowing into the head of Fishing lake has an upward northerly course of four miles, and flows out of a lake about a mile wide and six miles long, running north-west. Coarse, grey gneiss occurs at the outlet of this lake. This point is thirteen miles north of the last gneiss seen near the head of Eabamet lake, and, as the strike of the Huronian rocks above the latter is east and west, the belt to which they belong has a possible width of the above amount, but it probably does not extend more than eight miles north of the head of Eabamet lake, and it may be connected with the Huronian belt to the south-west, extending along the Albany from near the Etow-i-ma-mi branch to the outlet of Patawonga lake, a distance of about thirty miles. Continuing northward from the six-mile lake referred to, after ascending another short link of river, less than a mile long, we entered a lake which also measures six miles from south to north, but which has an extreme width of about five miles. The shores of this lake, almost all the way round, consist of boulders and shingle. Gneiss was found *in situ* at three places in the northern part. The surrounding country is level, with the exception of an isolated hill about two miles from the south-west side of the lake, which is conspicuous from the rarity of any inequalities in the surface of the country in this region, no other hills having been seen on our route since leaving Maminiska lake.

From the lake last described we would have reached the Attawapishkat river most easily by crossing the height-of-land to the north-westward and descending the Martin-drinking river. We afterwards learned that the first portage leading to this stream leaves the western bay of the lake, and not the north-western, where we searched for it in vain.

Having no guide, we followed the only route we could find—one which left the north-eastern extremity of the lake by a short portage into a tributary lake, four miles long, running in a north-easterly direction. From the head of this lake we crossed the height-of-land by a portage 880 paces long, and came to a lake one mile long, from which the water flowed north-eastward. The variation of the compass in this vicinity, from my observations, would appear to be less than 1° E.

Boulder River

We descended the small river, which has its source in this lake, to the Attawapiskat river, and found the distance, in a straight line, to be about twenty-five miles. The Indians do not navigate this stream, and as they have no name for it, we called it Boulder river, from the very bouldery character both of its bed and the country on either side. Its general course is pretty straight, and bears a little east of north-east. It consists of a series of short stretches of dead water, with bouldery rapids between them. At most of these we were obliged to make portages, on account of the small quantity of water flowing among the closely crowded boulders, although the descent might not be great. In some cases, however, a clear channel, down which canoes could be run, was formed through the midst of beds of boulders. The formation of these curious channels, which I have observed at bouldery rapids in many of the smaller rivers, north of the great lakes, may be due to the action of frazil or anchor ice in buoying up the boulders, so that they might be rolled or partially floated down the rapids by degrees, from year to year, until the existing channels were formed. We managed to float our canoes down some of the numerous rapids of this river by removing boulders. This process was resorted to whenever it could be done in less time than would be consumed in cutting out a portage-trail, unloading the canoes, carrying over everything and reloading. But in addition to clearing a considerable number of such channels, we made upwards of thirty complete portages, which required the trails to be cut through the woods in every instance. All these operations entailed a great amount of labor, occupying from the 5th to the 18th of August. Soon after crossing the height-of-land, I left most of my party to bring on our larger canoes and supplies, and pushed on in a light canoe to the junction of Boulder river with the Attawapishkat, in order to ascertain whether it was possible to reach the latter at all by this route.

At seven miles before joining the Attawapishkat, Boulder river falls into a lake three miles long, which the Indians call Sturgeon lake, from the abundance of this fish to be found in it. While in the act of setting our gill-net, the evening we camped on its shores, a sturgeon, measuring upwards of five feet in length, was caught in it. Below Sturgeon lake, the river is not so difficult as above; and after having advanced nearly to this lake with a sufficient supply of provisions for the remainder of the season, I sent back Messrs. MacMillan and Murray with two canoemen, as already stated, and continued the exploration with the aid of the remaining four voyageurs.

While the labour of cutting out portages and transporting our supplies was going on, numerous observations for latitude were taken, and I also explored the country for some distance on either side of Boulder river through a considerable part of its course. The surface consists of a series of rounded bouldery ridges of no great height, irregularly disposed, but running generally in a north-easterly and south-westerly direction, with swampy spaces, covered with a deep hummocky growth of sphagnum moss between them. In some sections, the timber had been burnt off the ridges and dry parts, exposing the naked surface, which was then seen to consist of boulders of all sizes and of a variety of kinds, mixed with some gravel and sand, and presenting a sterile and forbidding appearance.

On the dry ground, the timber consisted of black spruce, tamarac, balsam, aspen and white birch, but on the wet level tracts, it was principally black spruce. All the rapids in Boulder river were overhung by thick groves of good-sized white cedar, and the same tree was met with in groups in some of the swamps at a distance from the river. The rough-barked poplar occurs near the stream, but was seldom seen inland. Common varieties of gneiss were noted in a number of places in the bed of the Boulder river. There was no regularity in the general strike. Locally, the gneiss ran in various directions, from north-west to south-west.

Boulder River, near its source, showing the general character of the streams on the height of land S.W. of Hudson Bay.

Attawapishkat River

Having reached the Attawapishkat river, I left my supplies in charge of one man on an island, half a mile long, which I called Nolin's island in his honour, and taking the other three men, proceeded to explore the upward course of the stream. Its general direction was found to be about W. by N. At three miles we came to a very steep rapid, with a rise of fifty to sixty feet in about a mile and a quarter, which, for convenience, I called the Long rapid. Notwithstanding the strength of the current, my men poled our canoe all the way up. No rock *in situ* is seen, but nearly all the boulders which form the bed and shores of Long rapid are more or less angular, and consist of an indistinctly and coarsely stratified grey syenitic gneiss, consisting of grey felspar, bluish-white quartz and black hornblende. The weathered surfaces are rough and pitted. My barometers showed the head of Long rapid to be eighty feet above the level of the river at Nolin's island. A mile farther on, a lagoon occurs on either side of the river. I afterwards learned from the Indians of the country that there is a portage from the lagoon on the north side to another channel of the Attawapishkat, nearly as large as the one we were ascending, and which falls into it only thirteen miles, in a straight line, below this portage.

At the next rapid, which is only a short distance above the lagoons, the ascent is fifteen feet. Here the river rushes over and among large angular masses of pinkish-grey granite, consisting of an even mixture of quartz, felspar and mica, with a medium or fine texture. The appearances indicate that this rock exists in place just beneath.

The finer materials of the drift along this section of the river contain a large proportion of soft, yellowish limestone, but there is besides, a hard, bluish limestone, containing chert, which frequently occurs also as good sized boulders. In addition to these, among the more noticeable constituents of the drift of this region, may be mentioned the dark grey, finely quartziferous felsite or greywacké, resembling dark sandstone or friable quartzite in appearance, and holding rounded spots of a lighter colour, weathering into pits of the same form, which is so generally and abundantly diffused in the drift all over the country, to the west and south-west of James' bay. Hard reddish and brownish sandstones, impure jaspery iron ores and red jaspers, having the peculiar oolitic structure of those of the Manitounuck and the Animikie series, may also be mentioned among the constituents of the drift along this part of the river.

Ascending the Attawapishkat from the last-mentioned rapid, we passed a dozen other rapids, alternating with small lake-like expanses, and at eleven miles, in a straight line from Nolin's island, entered a direct south-westward continuation of the south-west arm of Attawapishkat lake, but three or four feet below its level and separated from it by a short rapid, flowing out of the middle of the south side of the latter. The northern channel of the Attawapishkat river, above referred to, is said to discharge from the eastern extremity of this lake, but this portion was not completely explored. Attawapishkat lake is, however, apparently about nine miles long. Its inlet is near the west end.

Lake Lansdowne[22a]

Still following up the river, for three miles from the inlet of the last mentioned lake, in which the rise amounts to only a few feet, we entered the largest sheet of water on the Attawapishkat, but strangely enough the Indians had no definite name for it. I, therefore, proposed to call it Lake Lansdowne, in honour of the Governor-General of the Dominion. As explained in my summary report, it was found to have a length of about thirteen miles, from south-east to north-west, and an extreme breadth of about ten miles. Lake Lansdowne is diversified by many beautiful islands, two of which measure about four miles each in length. The bays and points have all a north-east and south-west direction. A large, rounded, but not high hill, covered with second growth deciduous timber was seen in the western part of the lake, near the inlet or mouth of the upward continuation of the Attawapishkat river. The points and islands in the northern part of the lake are higher than elsewhere and have steep, wooded slopes, but they appear to be all composed of drift, and no rock *in situ* was seen anywhere around the lake. Long narrow moraines or rows of boulders extend south-westward off the extremities of some of the points and islands along the north-east side. Except where forest fires have run, large spruce and tamarac trees, and some cedars were observed on the islands and on the mainland near the lake, and also along the river between it and Nolin's island. The mouth of the upper division of the Attawapishkat river, which the Indians described as a wide tranquil stream, is in the south-western bay of the lake. The Martin-drinking river, by which we should have travelled from the second highest of the Eabamet chain of lakes, enters a bay on the south side between the inlet and outlet. On the opposite side of the lake, a brook is reported by the local Indians to enter the first bay northward of the outlet; and by way of this stream, there is said to be a canoe-route to a lake on the Weenisk river,[23] described as being as large as Lake Lansdowne, and called Wa-pi-quai-o lake. Another canoe-route to the same lake was stated to begin in one of the northern bays of Lake Lansdowne, and a third route, which, however, strikes the Weenisk river above the lake referred to, was described as beginning in a bay a short distance south-west of the one last mentioned. Wa-pi-quai-o lake would appear to correspond with "Weenisk" lake of Arrowsmith's map, as the Indians stated that it receives a large stream from the west and discharges the Weenisk river to the north.

A triangular island, measuring about a mile and a half on each side, is formed at the outlet of Lake Lansdowne by a small channel north of the main discharge, by which we entered. In the bed of the southern channel, at a mile below the outlet, there is an exposure, at low water, of a grey, friable, "pepper and salt" gneiss, with a few redish grains. The strike is S. 75° W., but the stratification is not conspicuous.

Attawapiskat River below Lake Lansdowne

Below Nolin's island, at the junction of the Boulder river, the Attawapishkat flows eastward and is interrupted by three rapids in the first four miles. Its course then forms a semi-circle to the southward, four miles in diameter, and has marshy lagoons on

[22a] Lake Lansdowne is now called Lake Attawapiskat.—W.G.M.

[23] The river referred to as the Weenisk, following the spelling on the published maps, is called the Wainusk by the Indians, which means the Woodchuck or Ground-hog (*Arctomys empetra*, L.)

Attawapiskat or Lansdowne Lak

either side. From the most south-easterly of these, a trail leads directly to Martin's falls on the Albany. An intelligent Indian, who had just come from that trading post, informed me that the trail keeps the same bearing all the way, and on plotting it upon the map of my surveys of the two rivers, the position of the post is found to be directly in the line of this trail. The distance is about sixty miles, and the Indians report the country as level and covered with sphagnum. The trail is said to be crossed by five streams flowing into the Attawapishkat and only one into the Albany.

At the termination of the above semi-circle, the channel we have been following joins the north branch from Attawapishkat lake, the two branches here flowing towards each other from exactly opposite directions and meeting in the same line which bears about N.N.E. and S.S.W. The distance from the southern outlet of the lake to this junction is about twenty miles in a straight line.

For thirty miles below this junction, the general course of the river is about east, and in this distance, it maintains a pretty uniform character, being alternately swift and rapid with long bends. The banks are of boulder-clay, ice-swept and sloping gently down from the brink to the summer level of the water, the whole height being about thirty feet. The surface of the country on both sides is low and level, as indeed it has been all the way from Lake Lansdowne. Except where the timber has been destroyed by fire, there is a good growth of spruce, tamarac, balsam, poplars and white birch along the banks of the river, but it does not extend far back, the country generally being open sphagnum swamps with small scattered tamarac and black spruce trees.

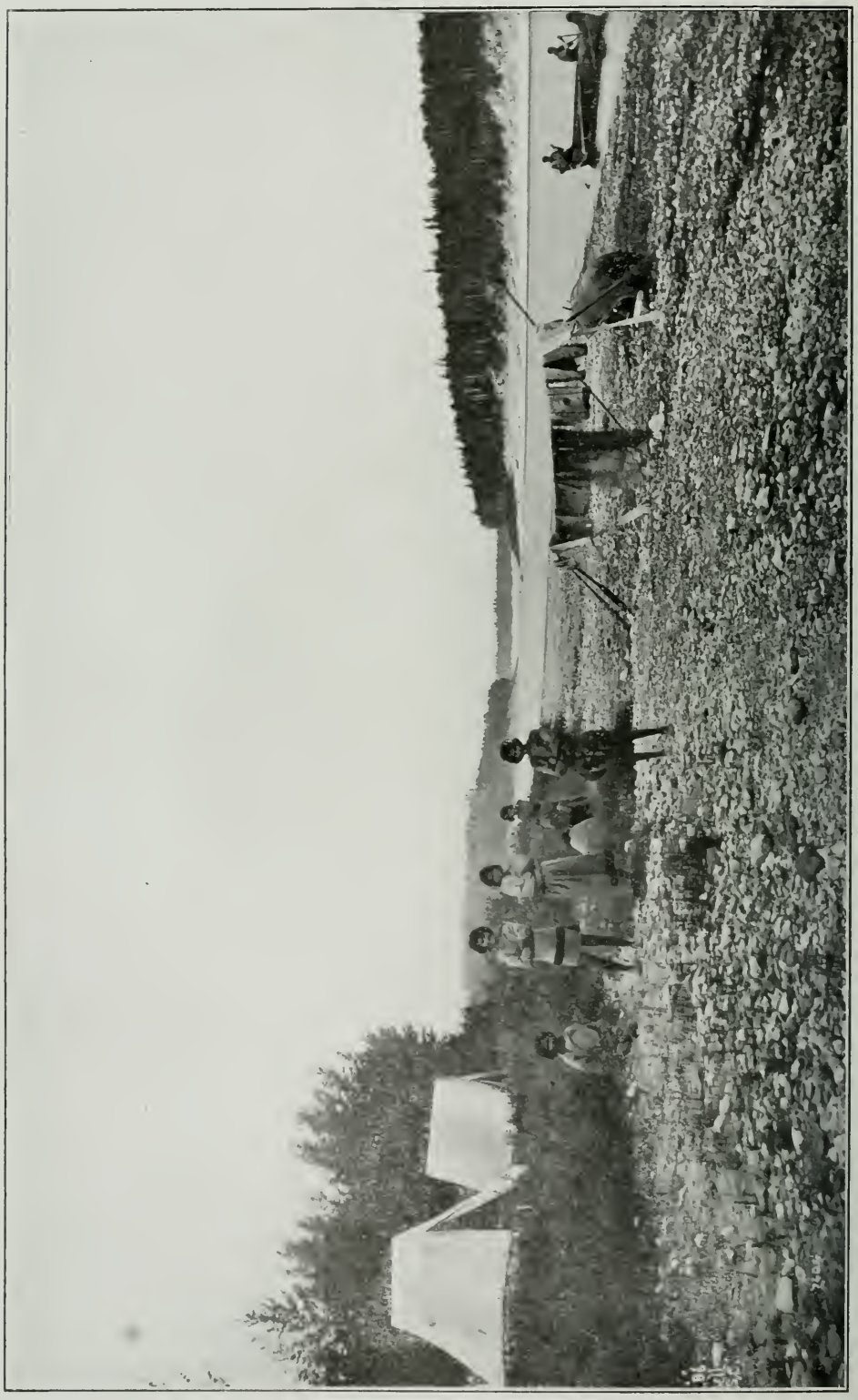
Three miles below the junction of the two channels, dark grey hornblende gneiss is exposed on the south side. It is distinctly bedded and strikes N. 50° W., angle 90°. Half a mile farther down, grey, strongly banded or ribboned gneiss strikes with regularity, N. 60° W. At a strong rapid, thirteen miles below the junction, a considerable area of fine-grained light reddish-grey contorted gneiss is exposed, the general strike of which is east and west. At nineteen miles below the junction, the river makes an "elbow" to the south-west and receives, at the angle, a large brook from that direction. On the south side, just below this brook, coarse grey gneiss is met with, striking from S. 40° to S. 60° W., but mostly in the latter direction, and dipping to the south-eastward at an angle of 40°. Two and a-half miles farther down, similar gneiss has an average strike of S. 50° W., with a dip to the south-eastward. Knobs and hummocks of this rock continue in the channel and on the right bank for more than a mile farther. In the last eight miles of the above thirty miles stretch, the river divides itself among numerous alluvial islands, one group of which (ten or twelve in number) is about two miles in breadth. Another Indian trail to Martin's falls leaves the river at the termination of this stretch. The distance is about fifty miles and the country traversed is described as a sphagnum swamp similar to that crossed by the trail to the same post which has been mentioned as leaving the Attawapishkat higher up. The old timber is still standing along the banks in some parts of the above section of the river, but as a rule, the forest consists of a second growth of poplars, white birch, spruce, tamarac and a little balsam. Here, as elsewhere, along this river, much of the timber has been killed by fires within the last few years, and only bushes and young trees have yet replaced it. Small black ash trees have been noticed here and there, all the way from Lake Lansdowne to beyond the termination of the present stretch, and white cedars have been of frequent occurrence, except where the ground is unfavourable for their growth.

At the termination of this thirty miles-stretch, the general course of the Attawapishkat changes to N.N.E., for about sixty miles, or to latitude 53° 0′ 0″, where a brook falls in from the left or west side In the first nine miles of this distance, the river divides into two main channels, with several smaller ones, all flowing sluggishly through a level country between low alluvial banks. The place where they come together again is called Mattawa by the Indians and is a favourite burying-place for their dead. From Mattawa, the stream again becomes swift and rapid, as it was above these islands, and the banks resume their ice-swept bouldery and clayey character.

Last Exposure of Archaean

At eight miles below Mattawa we passed the last exposure of Archæan rock on the river. At low water it forms a conspicuous island in the middle of the stream and consists of a strongly banded mottled grey gneissoid rock, but is composed of light-coloured felspar and black hornblende. The strike is straight and regular, N.5° E., and the dip is eastward at an angle of 45°. It is cut by a dyke of the same composition, ten feet wide, bearing due north, with smaller dykes running in other directions. A dislocation was noted running S. 60° W., towards which the stratification bends in approaching it from either side. Several boulders of a reddish grey syenite were observed at this locality, which exactly resemble the syenite in the Huronian rocks of Shebandowan lake.

Three miles below this rocky island, the river cuts through ridges of bouldery clay, capped with gravel, about 200 feet high, which here appear to run north and south. From where the river enters these earthy ridges, its course is eastward for about four miles,



Devonian limestone in banks of Attawapiskat river, about 200 miles from the mouth. (Photo by R. Bell)

after which it resumes the general north-north-east trend and flows with a smooth swift current, unbroken by rapids, such as are of frequent occurrence in the upper reaches, for twelve miles, between banks from twenty to forty feet high, composed of sandy and pebbly yellowish clay, with some boulders.

Horizontal Limestones

At the foot of an eastern "jog" in the river, about eleven miles farther on, or sixteen miles in a straight line from the above mentioned island of gneissoid rock, unaltered limestone is seen in the right bank for the first time *in situ*. The strata are horizontal and consist partly of compact yellowish drab, rather thin beds, together with a larger proportion of porous and rusty looking layers, associated with iron-stained yellowish marl. The only fossils observed consist of large fucoids which cover the surfaces of some of the beds. Below this locality, yellowish limestones are exposed almost continuously in the banks or bed of the river for the next thirty-four miles. They often form cliffs from fifteen to thirty feet high, which are sometimes a mile or two long. Thick layers were observed in a few places, but, as a rule, the beds are thin. The strata appear to the eye to be quite horizontal, except in two localities, where very local, gentle undulations were observed. The river in this section is wide, shallow and swift.

In the above N.N.E. stretch of about sixty miles, the Attawapishkat receives no tributaries from the west that we could detect, except two or three small brooks, and the larger one at its termination, which has been already referred to. But it is joined by a considerable number of branches from the east in the same interval, the largest of which falls in at about forty miles down or eight miles below the first appearance of the horizontal limestone. The latitude of the mouth of this river, from the mean of two very closely agreeing observations, is 52° 41′ 11″ A party of Indians of the country whom we met here had no name for this stream, and I propose to call it Streatfield river, after the Governor-General's secretary. The accompanying illustration is from a photograph looking down-stream, which was taken opposite the mouth of this branch. It is a good representation of the character of the Attawapishkat where it flows over the horizontal limestones.

Timber Conditions

Along the upper part of this stretch (of sixty miles) the timber is mostly green, and some of it is of fair size, but throughout the greater part of the distance the woods have been burnt at different periods many years ago, and, whether original forest or second growth, the trees are generally of small size. In some parts, spruce and tamarac are mixed with the poplars and white birch, but in others the coniferous and deciduous trees occupy separate areas. The sections of old timber and second-growth alternate at intervals of varying length with others more or less recently burnt and not yet reforested. The white cedar is scarce, but an occasional tree is found in favorable situations much farther down the river. The last black ash observed on the Attawapishkat was passed in this section. An Indian from the Wai-nusk river, who was ascending this stretch, and who had never before been so far south, informed us that he had here seen the cedar for the first time in his life. He had not yet noticed the black ash, and had never even heard the Indian name of the tree.

Black Fence River

The next stretch of the river from the junction of the above mentioned brook, in latitude 53° 0′ 0″, bears E.N.E., and is about thirty miles long, terminating where the stream is joined by a very large branch from the west, called the Muckitai-michigan or Black Fence river, which, as far as could be seen, has the same general course as the united waters for some distance below. The horizontal limestone is exposed on both sides nearly all along the upper six miles of the stretch under description, but in the remainder of it the banks and bed of the river consist of drift, which is largely made up of the limestone debris. The country on both sides is level throughout this portion of the river. A large brook falls in from the south at six miles above the termination of this section.

The timber along both banks in the upper twelve miles of this reach consists of old green spruce of fair size, but in the remaining eighteen miles the green and recently burnt timber alternate in short sections. In some parts the fire was actually burning as we passed by.

The general course of the Attawapishkat, from the junction of the Black Fence river to its mouth, is about S. 70° E., and the distance in a straight line about 135 miles. The river has now become much larger, and it flows for many miles with a swift current between rather low banks of drift, the country on both sides being level. This latter character continues all the way to the sea. From this large branch to the mouth, the Attawapishkat is characterized by great numbers of islands. In the upper half of this

long reach, only half-a-dozen tributaries were observed, and scarcely any at all in the lower half, which may be due to the even nature of the surface of the country and its general and uniform slope to the eastward, thus causing the drainage to pass off in parallel lines direct to James' bay.

Big Lake River

Nineteen miles below the Black Fence river, the Missi-sagaigan, or Big Lake river, a good-sized stream, falls in from the south, opposite the upper part of an island three miles long. In the sandy banks, about the lower end of this island, marine shells were observed for the first time. The species collected are *Saxicava rugosa*, *Tellina Grœnlandica*, *Cardium Islandicum* and *Mya truncata*. The barometric readings would give this locality an elevation of about 500 feet above the sea. Horizontal beds of limestone occur in the bottom of the river, five miles above this point, and again three miles below it, at the head of an island, which is over six miles long, and may be called Big island. From the foot of Big island, the river forms a semi-circle to the south, four miles in diameter, and then it divides into channels, which form four islands, with a total length of six miles. The water is shallow, and the descent rapid in these channels, each of which is flanked by cliffs, about twenty feet high, of yellowish, crumbling, earthy limestone. This rock, and indeed all the limestones met with so far on this river, resemble those of the Churchill and the Kenogami rivers, which are of Silurian age.

Devonian Fossils

For the next twenty-three miles, the river flows south-east, and has upwards of twenty islands in this part of its course. On one of these, about a mile in length, occurring about the middle of this stretch, and which we called Rainy island, the following fossils, as determined by Mr. Whiteaves, were collected in thinly-bedded limestone:

Favosites.—Species undeterminable. One fragment. Corallites about two inches in diameter; tabulæ complete.

Strophomena.—Species undeterminable. One valve.

Euomphalus (or *Pleurotomaria*), nov. sp. Four casts of the interior of the shell.

Straparollus, allied to *S. Nevadensis*. One cast of the interior of the shell.

Fragments of two other species of gasteropoda.

Orthoceras, nov. sp. Four or five specimens of the siphuncle only.

Mr. Whiteaves considers these fossils to be of Devonian age.

Throughout the above twenty-three miles, the river is generally wide and smooth, with low banks, composed of drift, while flat-bedded limestone is occasionally seen in the bottom. At the end of this distance, however, a sudden change takes place, and for thirty-three miles, or to the head of Lowasky island (the general course being east) the river flows with a rapid current, between cliffs, and among almost innumerable islands of yellowish limestones, all having an everage height of about forty feet. These limestones have a singular structure. They consist of great, spongey and cavernous masses, often occupying the full height of the cliffs, which may be described as gigantic concretions, alternating with thinly-bedded portions, the lamination of which appears bent at all angles, to accommodate itself to the spaces between the concretionary portions. Close to the latter, the lamination often follows the contours of their outlines, but farther away it dips at more moderate angles. The islets, which are thickly scattered among the larger islands in this part of the river, often appear to consist of single masses of this kind. Their surfaces generally present a massive and very uneven, or rugged, appearance, but they sometimes show numerous patches of more or less concentric lines, marking a subordinate or internal, indistinct concretionary arrangement, or the edges of the thin beds, which have remained in basin-like forms, in the depressions on their exteriors. Both the massive and laminated varieties have a yellow or yellowish-grey colour on fresh fracture, but the old surfaces have weathered to a blue or ash-grey.

The porous or cavernous masses are largely made up of fossils, although the number of species do not appear to be great, while the thinly-bedded inter-spaces contain but few. Mr. Whiteaves has determined the following from the specimens brought home, and he considers them to indicate the Devonian system:—

Favosites, species undeterminable. One fragment. Corallites polygonal; their maximum diameter five mm.; tabulæ complete, arched and crowded.

Meristella (*Whitefieldia*), nov. sp. allied to *Whitefieldia tumida*, Dalman (sp.) and *W. nasuta*, Conrad.

Strophodonta, species uncertain, but allied to *S. concava* or *S. ampla*.

Long cylindrical corals, like *Amplexus* or *Zaphrentis*, and a large trilobite, apparently allied to *Bronteus*, but resembling *Proctus* in the broad outer margin of the pygidium, were also observed, but owing to the friable nature of the rock, specimens for

identification could not be obtained. The numerous caverns, often of fantastic shape, but seldom of very large size, in the cliffs and islets of this part of the river, give the scenery a very singular and picturesque character. The Indians from the Equan river (the next large stream north of the Attawapishkat) report similar light-coloured, cavernous rocks along the lower portion of its course.

Lowasky River

At forty-four miles before coming to its mouth, the Attawapishkat divides into two channels. We followed the southern or smaller of them, which is called Lowasky river on Arrowsmith's map, and the island between it and the northern or larger channel, which has the above length (44 miles) may be called Lowasky island. The limestones above described extend for a few miles down the southern branch, and there may be small channels in this neighbourhood between the two branches, but in the rest of its course the Lowasky river presented little requiring description. The banks, which are generally low, consist of bouldery clay, with stratified gravel or loam occasionally at the top. Numerous shallow rapids occur. The tide extends to the foot of three such rapids, close together, about eleven miles from the mouth. A channel, which appeared to be a feeder, but which may be a discharge, occurs at four miles from James' bay. In the marshes on either side of the mouth of the river, we observed great numbers of geese and ducks as we passed out to sea, on the 7th of September.

General Notes

Throughout the long stretch from Black Fence river to the sea, the country on both sides maintains the same level and swampy character which has been described as prevailing higher up. The timber on the borders of the river, where still green, is smaller along this section than along the upper parts. Some portions, consisting principally of spruce and tamarac, appear to belong to the original forest, but much of it is no doubt second-growth, and these two species are then usually mixed with poplars and some small white birch. The growing timber, whether original or second-growth, is not often continuous for any great distance, being interrupted nearly the whole way by frequent sections of burnt ground.

From the barometric readings obtained on Lake Lansdowne, this sheet of water would appear to be about 960 feet above the sea, which shows that the general fall in the surface of the country between it and James' bay must be very gradual indeed. It is a remarkable fact that we did not require to make a single portage in the whole distance from this lake to the sea, and I could hear of no portages in the continuation of the river above the lake. The Indians describe the latter as a wide and tranquil stream, expanding into several lakes along its course.

Sturgeon are abundant in the lakes of the Attawapishkat, and they appear to constitute the principal food of the few Indians who inhabit the country. Whitefish are also caught, both in the lakes and along the river itself. Pike and suckers are abundant in all the waters. The Canada goose breeds in considerable numbers in the open swamps behind the wooded borders of the lower section of the river, and the young birds, ready to fly, were congregating in flocks, all along the lower stretch, in the end of August and the beginning of September. The dusky and other species of ducks were also numerous, and the yellow-legged plover was very abundant. We saw a few cariboo and several black bears while descending the lower part of the river.

The Indians of the Attawapishkat and Weenisk districts appear to have diminished greatly in numbers since the last sixty or seventy years. At that time several trading posts were maintained in this territory, where none now exist. We met with only a few families, but a good many Indian graves were noticed along the banks of the river. Those living far up the stream never go to the sea. One old man with whom we talked had never been at any trading post. Few of them had ever seen a white man before. One young man whom we fell in with on Attawapishkat lake accompanied us up to Lake Lansdowne, and after a few days' acquaintance, I had no difficulty in engaging him to go with us to James' bay, and thence up the Albany, from which he was to cross by one of the Martin's falls trails to his own river again.

After leaving the southern mouth of the Attawapishkat, we reached the Kapushkow river in our canoes in three hours and a half, the distance being only about ten miles. Starting from this river early next morning (8th September), we ran the whole distance to Fort Albany the same day, by sailing and paddling, arriving there late in the evening. The shore of James' bay between the two rivers is extremely low. The beach along high-water mark is sandy and marshy, but when the tide is out, reefs of boulders and stones, which look interminable, stretch out to sea as far as the eye can reach. The tide had fallen some time before we reached the Albany river, and in order to get past these reefs in our canoes we were obliged to go so far out to sea that the tops of the trees on the nearest part of the shore were barely visible at a few points. Even at high water,

it requires an experienced pilot to take a sail-boat over these extensive bouldery reefs. We were told that the water is so shallow that no large vessel could pass between the west shore of James' bay and "Agoomska" island. This large island lies nearer the west shore of the bay than is represented on the maps, and it is called by the Indians of the region Agimiski or Akimiski.

Albany River

Where the Albany river flows into James' bay, the coast is as low as possible, the water in front very shallow, and the country inland level and swampy. As the water of the bay is receding rapidly (in a geological sense), it becomes difficult to draw the line between the sea and what may be considered land. Fort Albany, one of the oldest and largest trading posts of the Hudson's Bay Company, is built on the south side of an island of the same name, six miles long and two and a-half wide, lying just inside the present mouth of the river. The channels on either side are of about equal size. Below it are two islands of sand and mud, covered with grass, sedges and bushes, but Albany

R. Bell, Photo., 1886. Albany River, Five Miles Below the Forks:
Showing Ice Swept Shores; "Pavements."

island is the first one which is timbered. As the mouth of the river and the adjacent shores are so difficult to define, all measurements of distances in the following description of the river will be taken from the Fort itself, which is situated about seven miles in, from the general line of the present mean high tide mark. Tide-water extends for only about three miles above the Fort.

As stated in a previous part of this report, in 1871 I made a micrometer and compass survey, with numerous latitudes, of the Albany from Abazotikitchewan lake down to The Forks, or junction of the Kenogami or Long Lake river, and thence up this river and via Long lake and Pic river to Lake Superior. A track-survey having been made the present season of the upper part of the Albany, from Lake St. Joseph to Abazotikitchewan lake, the lower section of the river, extending from the mouth to The Forks, was all that remained to complete the survey of the whole stream. It was only possible with the time and means at my disposal to make a track-survey of this part, on our return journey last autumn, but this was done with great care, and having ascertained the latitude and the variation of the compass in numerous places, I think the resulting map will prove very nearly correct.

Two Hundred and Fifty Miles of Steamer Navigation

In size, the Albany is comparable with the Ottawa, and at high water it might be navigated by powerful river steamers from the mouth to Martin's falls, where the first portage occurs, a distance of about 250 miles, following the general trend of the river. Its upward course, from Fort Albany to The Forks, bears about S. 45° W. (true), and the distance, in a straight line, is about 131 miles. For sixteen miles above the Fort, the river is wide, between the main shores, and full of islands of various sizes, and although the descent in the above distance is rapid, this portion may be called its delta. The channels spread widely over the flat-lying Devonian limestones, and the Lower and Upper Big "Falls," the strongest rapids below Martin's falls, occur in this part. Big island, which is the largest of this group, is six miles long. At thirteen miles from the Fort, a channel leaves the main river on the north side, and flows directly to the sea, falling into it several miles northward of Albany island.

For nearly twenty miles above the head of the delta, the river flows in a single channel free from islands, but from thence upward to The Forks, a considerable number are met with. The largest of them are Fishing Creek (five miles long), Black Bear (seven miles), Norran's and Chee-pye islands.

Some rivers and numerous brooks fall into the Albany below The Forks, from the swampy country on either side. The larger tributaries are Low Fishing creek from the south, almost opposite Fort Albany, Upper Fishing creek, from the north, at about one-third the distance to The Forks, and two other large brooks from the same side a few miles below it; Chemahogan river, from the south, at two-thirds of this distance, and the Chee-pye river, eight miles farther down. The latter is the largest branch below the Kenogami. The Henley river falls in from the north, ten miles below The Forks. Henley House, a former Hudson's Bay Company's post, was built on a gravelly island, which is now being swept away, at the mouth of this stream. Several lakes, abounding in fish, are said to occur on the course of this river.

From The Forks all the way down to the delta, the Albany flows in long sweeping curves, with a pretty uniform current, broken by occasional rapids. The elevation of The Forks, from barometric observations, is about 300 feet over the sea, which would give an average fall of about two feet in the mile, following the course of the stream. In two of the stretches, known as the "Long Openings," the river is so straight that, sitting in a canoe and looking from one end of them, the sky and water appear to meet on the horizon.

The country on either side is quite flat, and behind the strips of forest, which extend to a varying breadth from the banks of the river, it is covered with sphagnum, with only stunted tamaracs and black spruces at wide intervals. In some parts it is so open as to be called "plains," and on these the cariboo are found occasionally in considerable numbers, especially during the winter.

Bluffs of stoney clay, fifty feet or more in height, occur along some sections, but, as a rule, the banks are lower. Both sides are completely ice-swept throughout the entire length of this stretch. There is often a cut-bank a few feet high at the top, but from the foot of this the wide shore slopes gradually down to the low-water level. The upper portion of this slope, comprising the greater part of its breadth, is paved with boulders and worn stones, all crowded closely together and forced down to an even surface by the repeated moving pressure of the river ice as it is carried rapidly along during the spring freshets. The rise and fall of the river between high and low-water marks would appear to average nearly thirty feet, but where temporary ice-jams have occurred, it sometimes exceeds this. The Indians say that it rarely overflows any of the country beyond the banks.

Flat-lying Beds of Limestone

Thin horizontal beds of light yellowish-grey limestone, of Devonian age, begin at the first rapid, about three miles from Fort Albany, and are exposed almost continuously in the bed of the river for several miles above. The descent in the stream is so rapid that the thickness of the level strata over which it falls, must amount to, at least, twenty or thirty feet in this part of the river. Flat beds of similar limestone were seen here and there, sometimes covering considerable areas in the bed of the river, but rarely in the banks, to within about fifteen miles below The Forks. From this circumstance and owing to the level and undisturbed nature of the country, as well as from the abundance of angular fragments of Devonian limestone in the drift all along, there is no doubt that the Albany flows over flat-lying strata of this system, from the point above named to its mouth. The following is Mr. Whiteaves' list of the fossils collected in the above section of the Albany:

Syringopora Hisingeri, Billings. One small fragment.

Heliophyllum Canadense, *Billings*. One small but nearly perfect specimen and two fragments.

Favosites hemispherica, Yandell and Shumard. One fragment. Corallites one mm. in diameter: tabulæ complete.

Favosites, species indeterminable. Fragments. Epitheca thick and strongly developed: corallites two mm. broad: tabulæ complete.

Dictyonema, species indeterminable. One specimen.

Ptilodictya Gilberti, Meek, var. One specimen which resembles Meek's species in its microscopical characters, but in which the frond is apparently undivided.

Strophomena rhomboidalis, Wilckens. One well-preserved and nearly perfect specimen of each valve.

Strophodonta demissa, Conrad. Four ventral valves.

S. Patersoni ? Hall. One fragment.

S. concava ? Hall. An exfoliated cast of a ventral valve.

Orthis, species indeterminable. One specimen.

Spirifera, two or three species. Fragments only.

Meristella, nov. sp., allied to *M. unisulcata*, Conrad.

Atrypa reticularis, L. Two specimens.

Centronella glans-fagea, Hall. One perfect specimen.

Conocardium trigonale, Conrad. Two specimens.

Proetus crassimarginatus, Hall. One pygidium.

Mr. Whiteaves remarks that the above fossils "are clearly of Devonian and probably of Lower Devonian age."

Beginning at about fifteen miles below The Forks and extending thence for some miles up-stream, yellowish limestones, some of the beds being of a very spongy or finely vesicular character, are exposed at a few places along the north-west shore of the river. These limestones may belong to the Upper Silurian system, like those higher up the Albany and also on the Kenogami. (See Geol. Survey Report for 1871.)

Marine shells of Post Pliocene age, washed from the river banks, were observed in many places all the way from the sea to The Forks. They were abundant in a modified grey clay in the north-west bank, from Cap island, thirty miles below The Forks, for a number of miles upward. The following species were collected in this section: *Tellina Grœnlandica*, *T. proxima*, *Saxicava rugosa* (valves closed), *Cardium Grœnlandicum*, *Mya truncata* (with the epidermis), *Astarte Laurentiana*.

Forest fires have destroyed much of the timber along the banks of the part of the Albany now under description. Old spruces and tamaracs of good size are still green in some sections, but second-growth timber, much of it well grown up, prevails for the greater part of its length. A good deal of both kinds have been only recently burnt. In addition to the spruce and tamarac, balsam, aspen, rough-barked poplar and white birch occur all along. Banksian pine and ground maple were observed in the upper part. White cedar was first seen about twenty miles below The Forks. Grey elm and black ash were noted on the Kenogami just after we left the Albany or some distance farther north than they were observed when surveying this river in 1871. Groves of both these kinds of trees are found on the alluvial flats at the mouths of all the branches of the Kenogami. Cedar of good size is common all along the banks of this stream. It may be remarked that the occurrence, or otherwise, of certain trees along a river like the Albany may be due to the nature of the ground as much as to latitude.

The Kenogami river and Long lake were surveyed and reported upon in 1870 and 1871, and nothing requiring special description in this place was observed on our homeward journey, with the exception of some facts as to the drift, which will be mentioned further on. The rocks along the Black river, by which we travelled from Long lake to the Canadian Pacific Railway line, as stated in my summary report, were found to consist of crystalline schists and diorite, granite, syenite and gneiss, but further exploration will be required in this region before anything definite can be said as to their distribution.

Courses of Glacial Striae

The glacial striæ were carefully looked for wherever the solid rock was exposed, and their course was recorded in all cases where it could be distinctly seen. Exceptional instances, such as those on nearly vertical walls of rock, or on very uneven surfaces, are omitted from the following list. The bearings refer to the magnetic meridian, but the differences between them and the true bearings are not great, as the line of no variation passes through the central part of the region which they cover.

1.	Minnietakie lake, 8 miles from S. W. extremity	S. 45° W.
2.	do. 3 miles S. of Abram's Chute, at the outlet	S. 40° W.
3.	Abram's Chute	S. 10° W.
4.	Islands in the middle of Abram's lake (below Chute)	S. 40° W.
5.	Island in Lonely lake, 10 miles due east of H. B. Co.'s post	S. 60° W.

6. Point in Lonely lake, 13 miles eastward of H. B. Co.'s post ..... S. 25° W.
7. Point on N. shore of Lonely lake, 16 miles eastward of H. B. Co.'s post.... S. 55° W.
8. Rapid at mouth of Root river, E. extremity of Lonely lake ..... S. 45° W.
9. Root river, 5 miles in a straight line from its mouth ..... S. 50° W.
10. Root river, 10 miles in a straight line from its mouth ..... S. 45° W.
11. N. side of L. St. Joseph, 4½ miles from W. extremity ..... S. 30° W.
12. Western mouth of Cat river, 9 miles from W. extremity ..... S. 45° W.
13. Island in Lake St. Joseph, 18 miles from W. extremity ..... S. 60° W.
14. Islet in Lake St. Joseph, 4 miles E. of east mouth of Cat river ..... S. 15° W.
15. Islet in Lake St. Joseph, 7 miles E. by S. of mouth of Cat river ..... S. 45° W.
16. Fall Fishery on N. shore of L. St. Joseph, 44 miles from W. end ..... S. 30° W.
17. Extremity of N. arm of Lake St. Joseph, 50 miles from W. end ..... S. 30° W.
18. Northern outlet of Deer Lodge lake, on the Albany river, 13 miles below Lake St. Joseph ..... S. 20° W.
19. First Kagami portage, Albany R., 22 miles below Lake St. Joseph..... S. 40° W.
20. Albany river, 2½ miles below Etow-i-ma-mi Branch ..... S. 25° W.
21. Narrows about middle of Maminiska lake ..... S. 65° W.
22. Middle of Patawonga lake ..... S. 75° W.
23. Outlet of Eabamet lake ..... S. 80° W.
24. North shore and also head of Eabamet lake ..... S. 75° W.
25. Inlet of Sturgeon lake, Boulder river ..... S. 70° W.
26. Attawapishkat river, 3 miles below junction of the two channels from lake of the same name ..... S. 60° W.
27. Attawapishkat river, 13 miles below the above junction ..... S. 42° W.
28. do. 22 miles below the above junction ..... S. 22° W.
29. do. 23 miles below the above junction ..... S. 15° W.
30. do. Last exposure of Archæan rocks, or 8 miles below Mattawa .....S. to S. 10° E.
31. Attawapishkat river (on limestone), about 75 miles from southern mouth of river ..... S. 18° W.
32. Attawapishkat river (on limestone), about 66 miles from southern mouth of river .....S. 8° to 12° W. (Old set.) S. 60° to 70° E. (New set.)
33. Attawapishkat river (on limestone), at head of Lowasky island, about 44 miles from southern mouth of river ..... S. 20° W.
34. Attawapishkat river, southern channel or Lowasky river, about 40 miles from southern mouth of river ..... S. 35° W. Older, all round to S. 80° W., newer.

(At this locality the striæ are newer in proportion as they become more westerly)

35. Kenogami river, 8th Portage (in going up), about 20 miles below Pine lake S. 40° W.

From the foregoing list it will be observed that the general direction of the glacial striæ is to the south-westward, as it is elsewhere throughout the great Laurentian region between James' Bay, Lake Winnipeg and Lake Superior. In descending from the Laurentian plateau along the Attawapishkat river the course of the striation becomes more and more southerly, but on the horizontal limestones farther down the stream it runs in various directions between west and south at the same localities.

Character of the Drift

The drift (principally boulder-clay) which overspreads the Palæozoic basin westward of James' Bay appears to be a continuous sheet varying probably between thirty and ninety feet, as far as can be judged by the sections along the rivers. Over the generally level surfaces of the Laurentian rocks farther west, the thickness is more variable, but it seldom appears to exceed 100 feet, and it becomes thinner and more irregular as we rise higher and get farther inland, and in these regions the fundamental rocks protrude themselves more frequently through it. It is of a looser and less clayey nature on the higher grounds than elsewhere, and consists largely of washed gravel and shingle.

Along the Attawapishkat, Albany and Kenogami rivers, as well as on the west coast of James' Bay, the most remarkable feature in the composition of the drift is the abundance of pebbles and boulders of dark grey granular siliceous felsite or greywacké. It constitutes the greater number of the boulders and pebbles of the extensive reefs which have been referred to, between Akimiski island and the west shore, and is abundant among the boulders of the coast between Rupert's house and Moose factory.

Well-rounded fragments of this rock are also found along the Moose and Missinaibi rivers, and as far west as Lonely lake, and southward to Lake Superior. It is characterized by round spots, from the size of a pea to that of a cricket ball or larger, of a lighter colour than the rest of the rock, which weather out into pits of the same form. Microscopic sections show that it is composed principally of small angular grains of felspar with others, somewhat rounded, of quartz, the interspaces being filled in with a dark green amorphous mineral. This rock occurs *in situ* on Long Island, off Cape Jones, on the east main coast, where it strikes south-westward or with the greater length of the island. The same rock, no doubt, continues under the sea for some distance in the direction of its strike. The abundance also of rounded pieces of hard, banded, siliceous hæmatite in the drift of both the Attawapishkat and Albany rivers is another striking feature which was alluded to in reference to the latter in 1871. (Geol. Survey Report for 1871, page 112.)

After careful observations as to the nature of the drift along the rivers mentioned, the following appears to be about the relative abundance of its boulders and pebbles: the unaltered limestones which occur *in situ* immediately beneath; the dark grey siliceous greywacké above described; compact hard blue limestone; gneiss, syenite and granite; crystalline dark, grey and mottled and porphyritic diorites; slaty and jaspery banded hæmatites, compact siliceous magnetites, sometimes consisting of pure ore and fine-grained quartzite in thin alternate layers; quartzites of different shades; hard red sandstones and conglomerates; chloritic and hornblendic schists; dull red jaspers with oolitic structure like those of the Manitounuck or the Animikie series, or mixed with streaks and small disseminated spots of the peroxides of iron; compact amygdaloids; brecciated hard blue limestone; drab-coloured clay ironstone.

Extent of Polaeozoic Rocks

From our present knowledge of the distribution of the flat-lying Palæozoic rocks west and south-west of James' Bay, it is pretty certain that they occupy an area as extensive as the whole region between the Ottawa river and Lakes Ontario, Erie and Huron. The contours of the outer margins of their basin, as well as those of the different horizons within it, as far as they have yet been determined, indicate that its geological centre or highest point is under James' bay, off the mouth of the Albany river. In such an extensive and undisturbed basin, the occurrence of Carboniferous rocks might appear possible, and if they existed at all it would probably be near this centre. But the total absence of any trace of them in the drift which has come from that direction, and spread itself over the extensive region alluded to, leaves very little hope of finding such rocks in this part of the Dominion. The Devonian rocks no doubt underlie a great part of James' Bay, and they probably occupy a still greater area of the extraordinary level bottom of the main body of Hudson's Bay itself, and here there would be a greater probability of the occurrence of Carboniferous rocks than in James' Bay. Yet no evidence of their existence has so far been afforded by the drift of the shores of the larger bay, or in any part of the surrounding country which has been examined.

Judging from the approximate distribution of the rocks in Hudson's and James' Bays, and the courses which were probably followed by the drift, as indicated by the glacial striation all around these bays and in the great interior regions to the south-west of them, the drift of the country to the west and south-west of James' Bay would be derived from the bottom and east side of this bay, or it may have partly come originally from the site of Hudson's Bay, and thence been transported over the floor of James' Bay to the country referred to.

On the Kenogami, at six miles by the stream above the mouth of the large southern branch called the Bagutchewan, the river makes a sudden bend to the north, and about a mile farther another similar bend. These unusually sharp curves, which are unlike any others in the course of the stream, appear to be caused by the river traversing pre-glacial excavations in the Silurian strata, which here consist of dull-red, coarse, somewhat indurated arenaceous marl, with green blotches and layers. These excavations had become filled up with loose materials before the formation of the present river channel. At the lower bend, gravel fifty feet deep is exposed in the south bank. At the upper bend, the excavation of the Silurian marls is plainly seen. Starting from the level of the river, the lower ten feet of the filling of this hollow consists of boulder-clay. Upon this rests a bed, six to eight feet thick, of soft lignite, containing many flattened stems of small trees, which are partially carbonized, but are somewhat elastic when newly excavated and still wet. The lignite bed is overlain by thirty or forty feet of rudely stratified red and grey drift, holding rounded boulders and many pebbles. Marine shells were observed in the drift along the Kenogami almost up to this point, which, according to my barometric readings, would have an elevation of about 500 feet above the sea.

Before concluding this report, I wish to acknowledge our usual indebtedness to the officers of the Hudson's Bay Company for personal courtesies or assistance in promoting the objects of our survey. I would mention the following gentlemen who aided us during the past season:—Messrs. Chief Commissioner Wrigley, Newton Flannigan, Alexander Matheson, John Hourston, R. C. Wilson, William Mackay and Isaac Hunter.

APPENDIX

List of Lepidoptera collected in the Southern Part of Keewatin District.

By Dr. R. Bell.

The following Lepidoptera were collected in 1883, while exploring the country from Wabigoon lake to Red lake, by way of Lonely lake, which adjoins on the west that explored in 1886. The species were determined by Major H. H. Lyman of Montreal, with the exception of the last two, which were named by the Rev. George D. Hulst of Brooklyn, at Major Lyman's request:—

1. *Pieris napi*, Esper., var. *oleracea-æstiva*, Harris.
2. *Argynnis polaris*, Boisd.
3. *Grapta Progne*, Cram.
4. *Limenitis Arthemis*, Drury.
5. *Pamphila metacomet*, Harris.
6. *Callimorpha Leeontei*, Boisd.
7. *Euprepia Americana*, Harris.
8. *Apamea nictitans*, Bkh.
9. *Heliophila pallens*, Linn.
10. *Charodes transversata*, Drury.
11. *Metrocampa margaritata*, Linn., var. *perlata*, Guen.
12. *Sicya macularia*, Harris.

ALBANY RIVER

LAKE ABAZOTIKITCHEWAN TO MOUTH OF KENOGAMI RIVER[23a]

By Robert Bell

Gneiss, striking from west to north-west, is found all around the southern part of Lake Abazotikitchewan, but in going northward, dark crystalline trap, like that of Lake Nipigon, (see my Report of 1869), is met with on the shores in approaching the inlet of the Albany, which is from the north-west. On a small island, near the inlet, a dark coloured granite and a green hornblende rock are cut by a trap dike five feet thick, running north-west and having a basaltic structure, the columns being at right angles to the walls. From the inlet of Lake Abazotikitchewan, the course of the Albany river is south-east for eight miles, when it enters Makokebatan lake. In this section seven rapids, but no portages, occur and the width of the river varies from ten to twelve chains at the rapids to more than half a mile in the smooth places between them. Gneiss running N. 70 deg. W. was observed in one place in this section of the river.

Makokebatan Lake

From the head of Makokebatan lake to Martin's Falls, a distance of fifty-six miles, the general course of the river is N. 70° E. Makokebatan lake is nearly straight, and measures sixteen miles in length by one and a half in breadth. No rock *in situ* was seen upon its shores, which are strewn with small, rounded boulders, interrupted in some parts by sand beaches; and the country all round is so low and level, that, looking from one end of the lake, the land cannot be seen at the other. At the eastern extremity of the lake the Albany flows out by two channels, which only come together again at Moosewaké lake, nearly twenty miles farther down. Ten miles below Makokebatan lake, the northern channel enters the lower part of Washi-sagaigan or the lake of the Narrows. This part of the lake is four miles long, but the Indians informed me that the upper division approached close to a bay on the north side of Makokebatan lake, and that a portage leads from one to the other. This would give a length of twelve miles more, or sixteen in all, which is equal to that of Makokebatan, and the Indians also consider these two lakes to be of the same length. Washi-sagaigan was also formerly called Gloucester lake from a Hudson Bay Company's post of that name, which existed many years ago at the Narrows.

The distance from the Lake of the Narrows to Moosewaké lake is about five miles. Fine micaceous and dioritic schists (like those already described) running S. 65 deg. W. occur at the east end of the former, and again running S. 30 deg. W., at the west end of the latter; while on the river, between these two localities, is exposed a massive, reddish-grey, micaceous gneiss, much of which is thickly studded with crystals of light red feldspar, giving the rock a coarse porphyritic appearance.

Moosewake Lake to Martin's Falls

From Moosewaké lake to Martin's Falls, (a distance of about twenty miles), the river is full of islands and rapids, and the rocks appear to consist entirely of fine-grained, green, micaceous, dioritic and hornblendic schists, with which are associated small veins, strings and patches of quartz, and large veins and masses of coarse granite. Specks of copper pyrites were observed at one place in the dioritic schist. The average strike is west, varying to ten and sometimes to fifteen degrees both to the south and north of that course. The rapids mostly occur where great veins of the granite cross the bed of the river. Towards the end of the above twenty miles, bands of gneiss become interstratified with the schists, and just at Martin's Falls the latter have become entirely replaced by red and grey gneiss, apparently shewing a conformable passage from the Huronian into the Laurentian rocks. What appeared to be a similar blending of these formations was noticed last year in the neighbourhood of White lake.

Martin's Falls

At Martin's Falls there is only a rapid with a descent of about twelve or fifteen feet, down which light canoes are easily run. Fifteen portages occur between Makokebatan lake and Martin's Falls. The greatest single descent is at Ka-gé-ami, where the river descends forty-five feet at one chute. The surface of the country on either side of this

23a. From Report of the Geological Survey of Canada, 1871-2 pages 109-112.

section of the river appears to be only slightly undulating, and the soil in many places seems to be good. The general direction of the glacial striæ is about W.E.W., corresponding with that of the upward course of the river. Between Abazotikitchewan lake and Martin's Falls, twelve rivers and large brooks enter the Albany.

When at Martin's Falls, Mr. McKay, the gentleman in charge of the Hudson Bay Company's post there, kindly afforded me an opportunity of looking over the journals of the last forty years, which had been kept by his predecessors. From these I ascertained that the river between this point and James' Bay is open, on an average, six months of the year. Hay, turnips and potatoes have been successfully cultivated for a long time at this post, and cattle kept here thrive well.

Below the Falls

Below Martin's Falls the river changes its character entirely, becoming more uniform in breadth, depth and velocity of current. In the 120 miles which we surveyed to "The Forks" or junction of the Kenogami river, the width is from twenty to thirty chains, the depth in the middle from five to twenty feet (averaging about eleven), and the mean velocity about three miles an hour. Below the Forks, the river is described as maintaining similar characters all the way to the sea. A rapid occurs near the mouth, but it is said to be easily passed by boats going up and down. Except in very low water, the river would appear to be navigable by powerful steamers, with shallow draft of water, all the way from its mouth to Martin's Falls, a distance of about 250 miles. As shewing its freedom from obstructions, I may mention that the Hudson Bay Company's boats, in descending, are allowed to drift all night with the stream, in any part of this distance, the submerged top of a fir tree being sufficient to keep them in the channel.

From Martin's Falls to the junction of the Ogoké river, the Albany makes a curve to the north, equal to a semi-circle, measuring over thirty-seven miles. The Ogoké is nearly twenty chains in width where it joins the Albany. From this point the latter runs due east for twenty-one miles, and then turns south-east, and maintains that course for upwards of sixty-one miles, to the Kenogami, which it joins at right angles; the Albany, at this point, turns abruptly to the north-east, while the upward course of the lowest stretch of the Kenogami is south-west.

Character of River Banks

All the way from Martin's Falls to The Forks, the Albany is flanked by steep banks, either immediately overlooking the water, or rising at a short distance back from it. In descending the river their general height increases gradually from forty to about ninety feet, and they also become more regular and continuous in approaching The Forks. They are at first composed entirely of drab-coloured boulder-clay, capped with sand; but, after reaching the Palæozoic rocks, these deposits are by degrees replaced, in the lower part of the banks, by drab and chocolate coloured marls and shales, the upper part being usually composed of the boulder-clay overlaid by sand. The bed and shores of the river consist of either smooth, flat-lying rock, or small rounded boulders, packed closely together, and all brought by the drifting ice to a uniform surface, so that they bear a strong resemblance to a well laid pavement.

Gneiss, with the usual east and west strike, was the only rock seen *in situ* from Martin's Falls to the most northern point of the great bend; but, immediately on passing this, yellowish limestone strata made their appearance in the bed of the river. Similar limestones, and others of a grey colour, are seen in the bed and banks of the river, here and there, to within about twenty miles of The Forks, where they become replaced by the overlying drab and chocolate-coloured marls and shales. The inclination of the strata towards the sea is greater than that of the bed of the river, so that the line of division between the chocolate-coloured and the underlying drab marls and shales becomes gradually lower and lower in the banks, and at length sinks beneath the river bed. Layers of the two colours are interstratified with each other for a certain thickness at the junction, so that for some miles the banks have a banded appearance. In this interval a small quantity of soft, thin-bedded, grey sandstone occurs. The few fossils found in these rocks appear to indicate an equivalent of the Niagara formation; but in one place, just below the mouth of the Goose river, or three miles below the point where the river turns south-east, bright red marl occurs on the north bank, and on a small island, a mile farther down, some loose fragments of a bright bituminous coal were found. The Hudson's Bay Company's officers informed me that coal had never been brought into the country; and, considering that the conveyance of even light and valuable goods is so expensive in this region, this is only what might have been expected, so that I cannot suppose this coal to have been brought here by human agency.

The large proportion of boulders of a very dark-coloured granular quartzite, and the abundance of rounded fragments of a hard, banded, silicious hematite, containing usually about 50 per cent. of iron, which occur in the drift along the Albany, are worth nothing. These erratics have probably come from a long distance to the north-eastward, as indicated by their worn character and the direction of the glacial striæ.

The country on either side of the Albany below Martin's Falls is quite level. The steep banks drain a narrow strip of land on either side of the river, but beyond this great swamps appear to extend on all sides. Water is constantly oozing from the foot of the banks, rendering it very difficult to walk along the sides of the river, on account of the deep mud, except upon the boulder pavements already described. The Albany received nineteen rivers and large brooks between Martin's Falls and The Forks.

COUNTRY AROUND HEADWATERS OF SEVERN RIVER[24]

By Charles Camsell

* * * * * * * * * * *

A letter of instruction reached me there, directing me to proceed to Dinorwic, and from there to make a survey of a route to Cat lake, defining and mapping the eastern boundary of an area of so called Huronian rocks, whose western edge was examined by Mr. Dowling in 1893. On completing this work I was to go north from Cat lake across the height-of-land dividing the Albany from Severn river waters, and make a survey and examination of the rocks of the hitherto unexplored branch of the Severn river, called the Lake or Cedar river, descending this as far as Severn lake to connect with a survey of the western branch made by Mr. A. P. Low in 1886.

* * * * * * * * * * *

Outfit, provisions and two canoes were obtained from the Hudson's Bay Company at Dinorwic. The party left here on June 17th, and travelled as far as Lac Seul in company with Mr. McInnes, who there turned north-east to the Albany river. At Lac Seul I hired an Indian guide to take us as far as Cat lake by the Wenasaga river route, a river which enters Lac Seul about two miles east of its western extremity. This route has been explored by Mr. Fawcett, D. L. S., some years ago, and in 1902 Dr. Wilson and Mr. Johnston of this department also made a micrometer and compass survey as far as Cat lake, from which point they returned following the Cat river to lake St. Joseph, and thence out to Dinorwic by the Hudson's Bay Company's usual route.

At Cat Lake

We reached Cat lake on July 15, only to find the place deserted by all except two Indians. It was necessary that the services of another guide should be obtained here, to take us across the height-of-land and down the Lake or Cedar river, as our Lac Seul Indian had never been beyond Cat lake. A party of Crane Indians was expected from the north in a few days, so in the intervening time, I made a micrometer survey of the shores of Cat lake, not knowing at the time that I was duplicating the work of Dr. Wilson and Mr. Johnston. (See map, page 50.)

This work, on account of the stormy and unsettled state of the weather, occupied us until the 28th, and on our return to the Hudson's Bay post I found Mr. Williams of Osnaburgn house. He had come straight across to Cat lake by a route hitherto travelled only by Indians. I obtained a copy of Mr. Williams' notes and some sketches of the largest lakes; but he had no means of estimating his distances. The journey took him five days, and he reckoned the distance to be somewhat over 100 miles. Shortly after leaving Lake St. Joseph he got on to the waters of the Attawapiskat system, and on these he travelled by river and lake to within a few miles of Cat lake. A rough sketch of the route has been prepared and incorporated in the accompanying map of the Cat lake district. Williams lake, which is drained by the Sand river, and whose waters pass through Vermilion lake and river to the Attawapiskat, is the largest lake on the route, and is said by Indian report to be two days' travel from one end to the other, or almost as large as Lake St. Joseph. Mr. Williams describes the geology to comprise the usual Archæan granites and gneisses with only one band of a darker basic rock, crossing the Vermilion river above Vermilion lake.

Down the Lake or Cedar River

On July 29th, the party left Cat lake, after, with much difficulty, obtaining the services of a young Crane Indian, who was to act as guide down the Lake or Cedar river to Severn lake. Through a difficulty of interpreting my wishes correctly a misunderstanding arose, and he got the impression that we only wished to go as far as Pakhoan or Little Cedar lake, which is only about half way down the river to Severn lake. From Pakhoan or Little Cedar lake he refused to accompany us farther, and left for his own camp, while we had to find our way down the river alone.

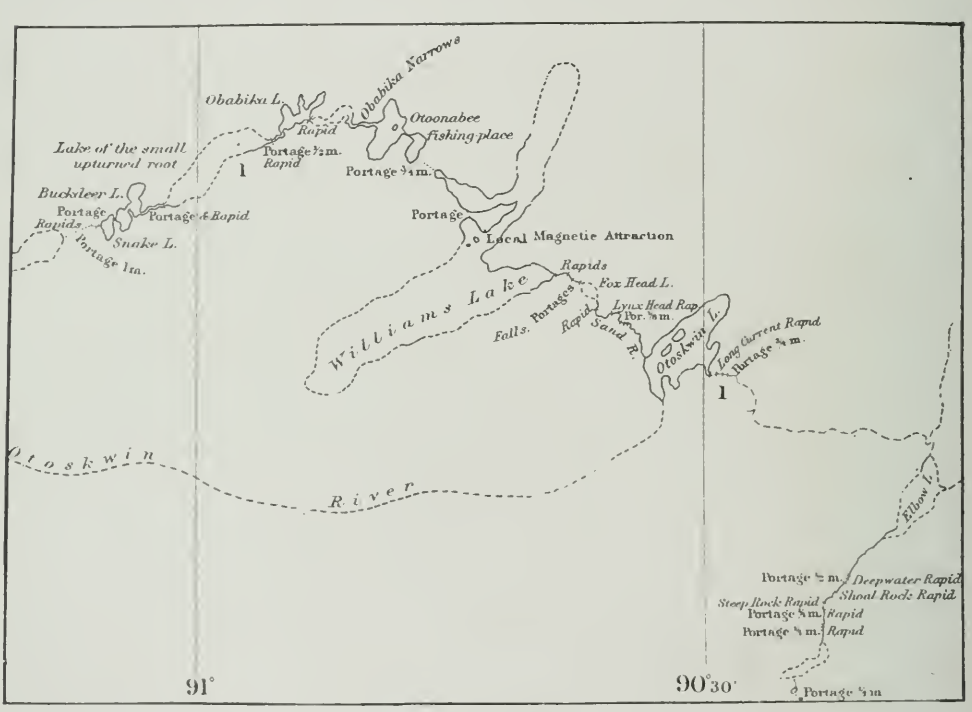
On August 14th, we reached our farthest north, a point fourteen miles below the junction of the Lake or Cedar river with the middle branch of the Severn, which the Indians call the Jackfish river. From here we were unfortunately compelled to return

[24] From Part A, Vol. XVI., pages 143-150, Geological Survey of Canada 1904.

owing to a scarcity of provisions, and our ignorance as to how far we were from Severn lake. I afterwards learned that another day's travel would have brought us to the lake and completed the survey. (See map, page 102.)

In returning, short side trips were made up the middle and other branches of the Severn river, and Cat lake was reached on August 30th. The following week was spent in making a trip forty miles to the north-westward to a lake (Wigwasikak lake), which is said to be the head waters of the central branch of the Severn river. Southward from Cat lake, the route followed took us west from Wapikik, or what Mr. Fawcett calls Pine Channel lake, through a series of lakes and portages to the Shabumeni lake, defining the north-eastern boundary of the large Huronian area before mentioned; and from Shabumeni lake I followed Mr. Dowling's route of 1893, down through Woman lake and Trout lake river to Lac Seul, which we reached on September 24th.

On arriving at Dinorwic, I found it necessary to go to Winnipeg to pay off my men and settle accounts, after which I proceeded to Ottawa, reaching here on October 10th.



Williams Lake.

Topography

The area covered by the summer's exploratory work is roughly enclosed by a parallelogram, the east and west angles of which are placed at Cat lake and Wigwasikak lake, the head waters of the central branch of the Severn; and the north and south angles at Severn lake, and the western end of Lac Seul. It occupies a part of the great uplifted peneplain of the Archæan protaxis, and is similar in character to that so frequently described by other geologists in its more thoroughly explored sections.

The general relief is even lower than is usually found in other parts of the Archæan, and the maximum relief seldom exceeds 100 feet above the level of the water. There are a few exceptions, the most notable of which occur on the Severn River watershed, where some isolated hills attain a height of 130 feet. These are usually granitic eruptive masses, which sometimes have very precipitous slopes, and are very noticeable features in the topography. Residual monadnocks of this description occur at Cat lake, Cedar (Kishikas) lake and at the mouth of the middle branch of the Severn river; while a range of hills, probably of similar origin, borders the western shore of Windigo lake, about twelve miles to the east of Cedar river. The highest hill in the whole area is situated about three miles west of Greenshields lake. It rises 300 feet above the level of the water, and is composed seemingly entirely of boulders and

drift material. Similar hills and ridges of moranic material occur in the neigbhourhood of the large one, also on the height-of-land between the Severn and Albany rivers, and in the country a few miles north of Cat lake. These hills form excellent landmarks and can be seen from a distance of several miles rising above the surrounding country. From the top of any one of them a good view is obtained, and everywhere we see the same gently undulating surface, and even skyline, typical of the Archæan area.

Lakes are more numerous on, and south of the Severn river divide, than on the area north of it. These all occupy more or less shallow rock basins eroded out by the action of the continental ice-sheet, their long axes usually lying parallel to the direction of the glacial striæ. Their shores are deeply indented, and beaches are rare, a few sand beaches occurring only on Cat lake and Whitestone lake.

The streams occupy only shallow valleys, and rapids and falls are common. In the distance between Greenshields lake and the mouth of the middle branch (Jackfish river), the slope of the land is much more pronounced, and here the river has cut itself a fairly well defined valley twenty-five or thirty feet in depth. A corresponding slope was noticed by Mr. A. P. Low on the western branch of the Severn river, which he descended in 1886. There is no very decided fall in any one place, except a long steep slope marked by a series of shallow rapids, the majority of which can be run.

Archean Geology

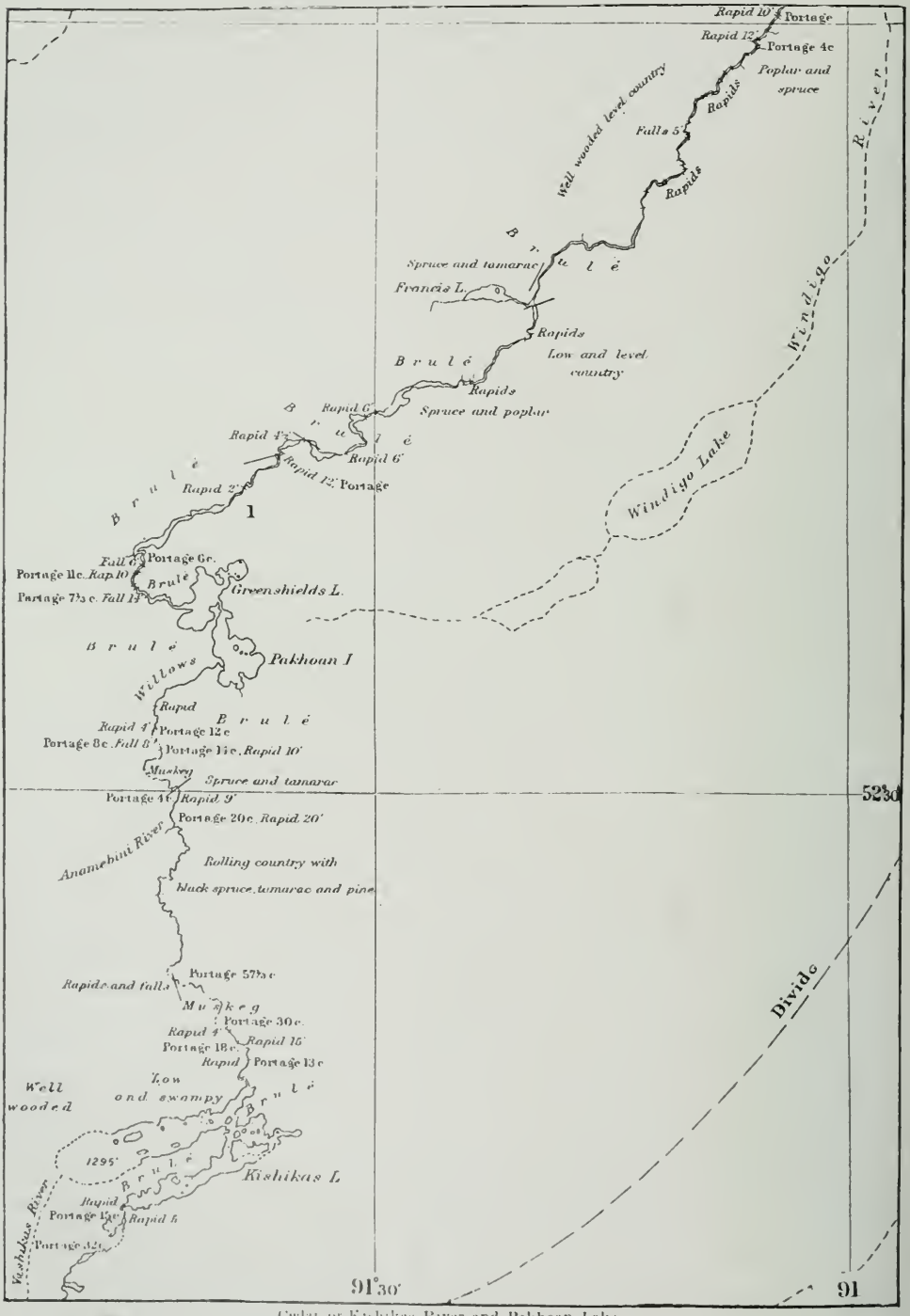
As has been already stated, the whole area is occupied by rocks of Archæan age, principally granites and gneisses, with a few bands of the darker basic rocks. The largest area of the so-called Huronian rocks lies to the south and west of Cat lake, and has been examined in different parts of its south and west borders by other members of this department. Mr. Dowling defined its western boundary, and Dr. Wilson crossed it by the Wenasaga river route. It was crossed this year in two directions, one by the same course as Dr. Wilson, and the other by a route from Wapikik lake to Shabumeni lake. By the latter route, the north-western extension of the area was traced to a distance of twenty-five miles east of Shaubumeni lake. The northern boundary of the area crosses Shabumeni lake about three miles north of its outlet, striking in a general direction north-easterly. The contact with the granitic rocks was not seen anywhere except at a point just east of Kay-gat lake, so that the boundary is only sketched in approximately, by following the strike of the rocks. On Shabumeni lake the strike is about 50 degrees, on Birch lake from 105 degrees to 120 degrees, on Kay-gat lake 75 degrees, and on the contact a couple of miles east of Kay-gat lake 145 degrees. The eastern boundary of this area appears to be very irregular, running out into several long, narrow tongues.

As reported by Dr. Wilson, the Wenasaga river flows through the area, southwesterly for about twenty miles, and going up the river beyond this, the Huronian belt is replaced by very coarsely crystalline granites and some gneisses. Two narrow tongues, however, of basic rocks intervene before reaching Gull lake. One of these occurs on the Sesikinaga river, and is perhaps a quarter of a mile wide. The other is crossed on the height-of-land between Cat river and the Wenasaga. The latter tongue is undoubtedly a continuation of the main body, for it was traced westward for a distance of five miles from the height-of-land portage. The other band may or may not be an altogether isolated area, but nothing resembling it in composition was noticed on the main area. The south-eastern corner of the main area extends very much farther eastward than any other part, and it is probable that a much larger and longer tongue projects out from here. The valley of Slate lake, which has been formed by the erosion of the soft calc schists, which make up this portion of the belt, can be traced eastward for six or seven miles beyond the lake, at which point it bends slightly to the southward, running approximately in the direction of Goose lake. Dr. Wilson also examined an area of Huronian rocks, north of the east end of Lac Seul; but it remains to be proved whether this area is continuous with the one on Slate lake. This I intended doing on my way back from Cat lake, but was unfortunately prevented by the impossibility of getting any guide to take us through that country.

North of Cat lake and on Cedar river there is an almost unbroken continuation of the granites and gneisses, with a predominance of the red granite variety. In a few places basic inclusions in the gneisses might indicate that larger bodies of the same rock would be found in the near neighbourhood; and the following places might be mentioned, where such conditions occur:—On the lake at the head of Cedar river; on the lower end of Cedar (Kishikas lake); on Cedar river, at the mouth of the Francis river.

Bands of Huronian (Keewatin)

A very narrow band of hornblendic rock crosses Cedar river, a few miles above the junction of the Windigo river; while a much wider band is met with just below the



Outlet of Kishikas River and Pakhoan Lake.

mouth of this river. Here, Cedar river takes a sharp bend to the west and flows in this direction for ten or twelve miles. The cause of the deflection is its entrance into this band of softer rocks, which it follows until it strikes against a steep bluff of eruptive rocks at the south-west angle, and it again deflected into its original course. The southern boundary of this belt follows closely the course of the river in its western trend; but its northern contact with the granite is covered by a layer of drift, and could not be accurately placed. Its width is perhaps two miles, and the strike slightly north of east. The central branch of the Severn river joins Cedar river in this belt of Huronian, and occupies a shallow valley in the wide depression caused by the excavation of these soft hornblendic rocks. Few outcrops of this belt occur, for the drift covering becomes much thicker in the lower parts of Cedar river. Dawes falls, just below the junction of the two streams, where the river has a drop of twelve feet, is caused by a band of hard siliceous hornblende-schist, striking diagonally across the river and dipping down stream at an angle of 45 degrees.

The large area of these basic rocks, south of the height-of-land has been referred by Mr. Dowling to the Keewatin series, and the two narrow bands, which are seen on Cedar river through their lithological similarity to the large area, may also be referred to the Keewatin.

Samples of the different varieties of rocks occurring in the several Huronian belts were taken, and thin sections are being made of those whose mineralogical composition could not be readily determined in the hand specimen. The Severn river specimens are all hornblendic rocks, varying from a massive amphibolite to a siliceous hornblende-schist. The latter is closely associated with a coarsely crystalline rock, composed essentially of hornblende and quartz, and no doubt the one is simply a phase of the other.

[Under the nomenclature now in use, the hornblendic and chloritic rocks classed as Huronian in this report should probably be called Keewatin.—*W. G. M.*]

The rocks on the Wenesaga river have been referred to by Dr. Wilson in the Summary of 1902; but one occurrence, which appears on the Sesikinaga river, and which he consequently did not visit, shows an interesting contact. A narrow band of pyroxenite, showing considerable metamorphism, and alteration on the surface to serpentine, is separated by a band of granite from a hornblende-schist, having alternate layers of quartz and hornblende in very thin laminæ. Closely associated with these exposures, and at no great distance from them to the east, is an outcrop of what Dr. Barlow has identified as a quartz-mica diorite. All of these strike about N. 60° E. and are separated from each other by narrow bands of later intrusive granite.

Conglomerate and Slate

The greatest variety of specimens was taken from Birch lake and the Shabumeni river, along the northern boundary of the large belt. Near the contact with the granitic gneisses the rock is a mica-schist, which changes shortly to spotted chloritic and hornblendic schist. West of these along the route, the following rocks are found: slate, conglomerate, quartzite and an altered quartz porphyry, massive fine-grained diorites, amphibolite and hornblende schist. Certain portions of the quartzite are highly impregnated with iron sulphide. The diorites are cut by numerous veins of quartz ranging in width from a few inches up to eight feet, and highly mineralized.

Glacial Geology

The whole area exposed shows a predominance of the action of erosion over that of deposition. In the central portion about the height-of-land, drift material covers a very small proportion of the surface, while bare rock exposures are common. These are always smooth, and frequently still retain the glacial markings. The general outline of the lakes conforms to the direction of the striæ, which at Cat lake is about N. 70° E., and they usually occupy shallow rock basins. A few of the lakes on and about the height-of-land occupy basins formed by an unequal distribution of morainic material. Cat lake itself is an example of the erosive force exerted by the moving ice. Its long axis lies N. 70° E., while several long, narrow bays cutting into the western shore have the same general trend. Many of the islands are composed of drift material, and conform to the direction of the striæ. They are long and narrow with rounded tops and gently sloping sides composed largely of boulders and having the appearance of drumlins or sowbacks. Whatever drift there is is made of material carried presumably but a short distance, boulders of granite and gneiss; but I also noticed some erratics of a hard bluish limestone which could only have been brought from the Palæozoic area bordering Hudson Bay. A large number of bearings of the glacial striæ on Cat lake were taken. The average gives a reading of N. 70° E. On Birch lake, two sets occur on the same exposure, one giving 55 degrees and the other 65 degrees. The latter, however, is the more constant. On Cedar river few striæ occur; those near the head water conform in a general way to those on Cat lake. One reading

near the mouth of Windigo river shows a great divergence from all the others, being N. 12° E., and the indications are that the movement was apparently towards the north instead of away from it. This is an isolated case, and no other striæ occur anywhere near it to check it. All the evidence, however, of the movement of the ice north of the height-of-land agrees with the results obtained by other explorers in this region, that the ice movement was southward instead of northward.

Lower down Cedar river the covering of drift becomes thicker. Sedimentary clays form cut banks fifteen feet high on the river just above the south-west angle.

Moraines and sand plains are numerous on the height-of-land, also in the neighborhood of Pakhoan or Little Cedar lake. Some of the former have been mentioned before as forming some of the principal topographic features. Two long parallel north-east and south-west ridges, rising to a height of 120 feet, are crossed in making the portages over the height-of-land. But the most important glacial hill occurs near Greenshields lake, and is 300 feet above the level of the water. It lies east and west with prominent peaks at either end, each higher than the centre of the ridge. From peak to peak is about half a mile, and beyond this the ridge slopes gently away to the level of the plain. The east and west sides are exceedingly steep, the slope being determined entirely by the angle at which the material of which it is composed will rest. It is composed entirely of boulders and gravel. A number of lower ridges and hills of the same material are irregularly scattered around the larger one.

Several moraines have been laid across the valley of Cedar river, and some of these deflect the course of the river, while others are cut through and form shallow rapids. About ten miles below the junction of the middle branch of the Severn a moraine, lying at right angles to the course of the stream, had dammed up the waters and formed a lake nearly three miles long and a mile wide, which, on the cutting down of the dam, has been transformed only recently into a huge meadow.

Timber, Soil, Etc.

Spruce, poplar, banksian pine, and birch are found everywhere over the whole district. White and red pine were only noted in the southern part of Lac Seul. One solitary white pine tree occurs on Slate lake, and this appears to be the northern limit of the tree in this district. Ash trees were observed here also for the last time on our way north. The white cedar is a rare tree, but it occurs on this east end of Slate lake, on Sesikinaga lake, on Cedar (Kishikas) lake, and also on Greenshields lake. On the shores of the last a few rusty looking trees are growing, and this is their northern limit. Mr. Williams, in his traverse across from Osnaburgh to Cat lake, reports seeing ash trees for the last time on the east shore of Elbow lake.

Large areas have been burnt along the route of the Wenasaga river, notably at Wenasaga lake, ten or twelve years ago, and at Big Portage lake, about five years ago; also on Gull lake. North of Cat lake, we enter, at the lower end of Cedar (Kishikas) lake, an area that has been burnt probably eight or nine years ago, and this extends to a few miles below the mouth of the Francis river, or a distance of over thirty-five miles. Eastward it extends at least to Windigo lake, ten or twelve miles to the right of the river, and westward as far as could be seen from the tops of the highest hills. This is generally being reforested with a second growth of banksian pine and poplar.

In very few places, either on the north or the south sides of the height-of-land, do the spruce and tamarack attain such a size as to make them economically important to the lumbering industry. On the shores and islands of Birch lake the best timber occurs; that on the branches of the Severn river is generally small.

Beyond the Hudson's Bay post at Lac Seul no farming of any kind is done. At Cat lake, some years ago, potatoes and other hardy vegetables were grown with indifferent success, but this has now been discontinued. Being so near the height-of-land they are liable to frosts at any time during the summer. When we were there a sharp frost occurred on the night of July 31st and also on August the 6th. The Crane Indian chief, who has built himself a house at Windigo lake, evey year raises a small crop of potatoes, which he first obtained from Trout lake posts. A great part of the country is either too rocky or swampy for agricultural purposes, and nothing will ever be grown on it, but there are portions particularly in the large belt of Huronian rocks, and in some parts of the valley of Cedar river, where the land is dry and the rocks are covered with a clayey soil that is good enough to raise some of the hardier vegetables. The region around the mouth of the Anamabine river is such a country, as also the clay belt below the mouth of the Windigo river. As a rule, however, the dry land only occupies a fringe along the water courses, while the country back of this is largely muskeg or rocky.

Moose and caribou are fairly plentiful in the Shabumeni and Birch lake section; and bears were frequently seen on the lower parts of Cedar river. White fish, pike and pickerel were caught with a net in all the larger lakes; but no trout were got anywhere. Sturgeon ascend Cedar river as far up at least as the mouth of the Windigo river, and in several places the natives have gone to a great deal of trouble in building weirs across the river to catch them.

Much delay was caused in our work by the inclemency of the weather, and the disadvantage of travelling through parts of the country without a guide. The season was very wet and cold, frosts occurring in every month. Snow fell first on September 10th and again on the 19th.

The discharges of all the larger streams were taken, and the fact established that what was considered to be the main branch of the Severn river is really not so large as the Cedar river branch. The discharge of these two streams was taken near the end of August, when the water was at its lowest stage. Cedar river was found to give 735 cubic feet per second, and the middle branch 503 cubic feet. At the junction, the middle branch is wider and deeper than the eastern branch, and it would appear to carry much more water; but there is a great difference in the relative velocities.

PRELIMINARY REPORT

on

AN EXPLORATION OF COUNTRY

between

LAKE WINNIPEG AND HUDSON BAY (Via BERENS AND SEVERN RIVERS)[25]

By A. P. Low

. . . . . .

The height of land portage, six hundred and seventy-five yards long, passes through a gulley between hills from fifty to seventy-five feet high, and ends on the north side at a small lake on the headwaters of the middle branch of the Severn river. This lake lies about fifty feet below that at the other end of the portage, and shows that the land on the north side falls abruptly. The dividing ridge stretches away in a south-easterly direction, rising from fifty to one hundred and fifty feet above the water surface.

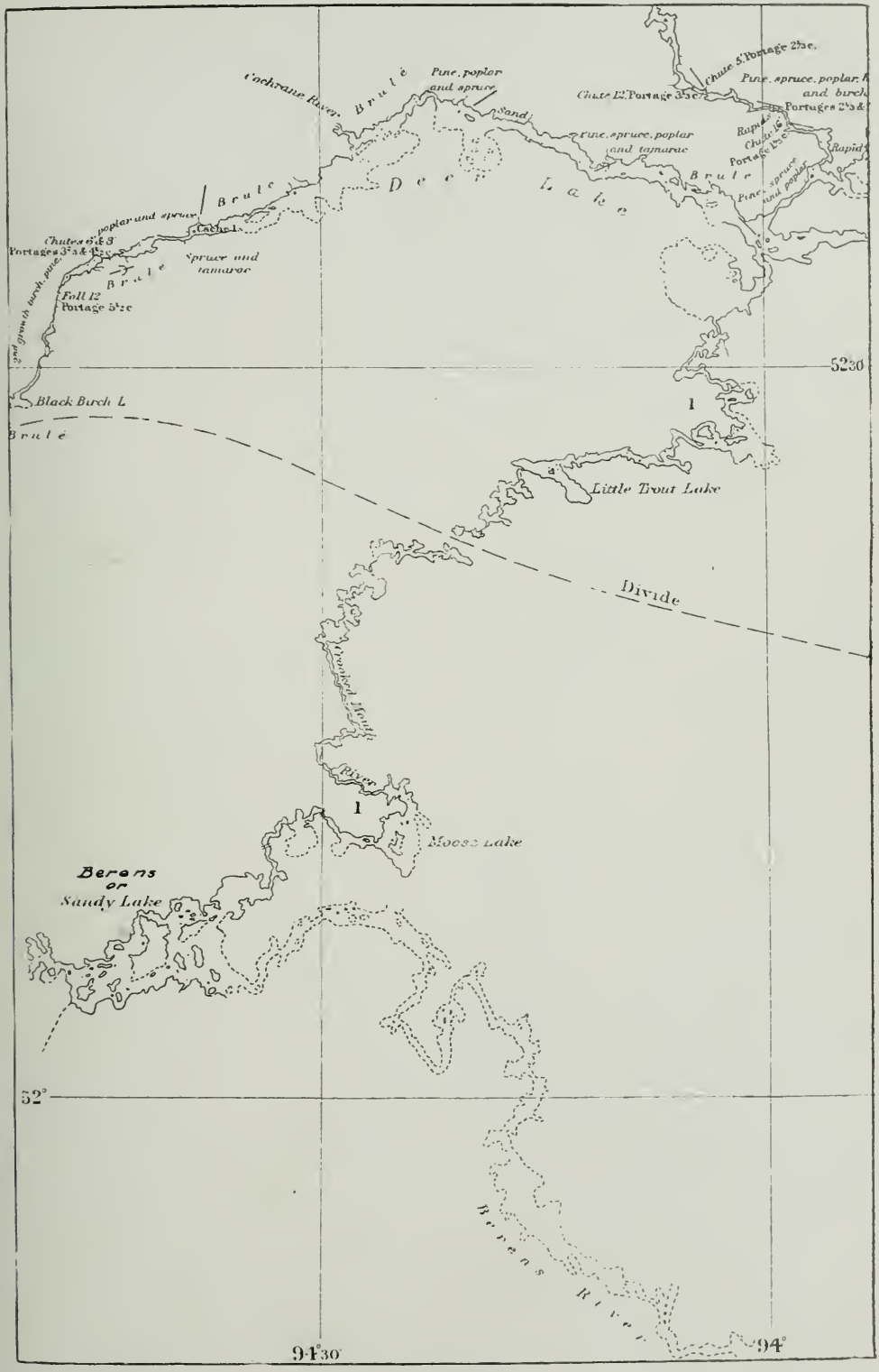
The first lake or pond, one-quarter of a mile long, empties into a second by a brook too small and shallow to float canoes, so that a portage of thirty-five yards has to be made between the lakes. The second lake, three-quarters of a mile in length, empties into Black Birch lake by a brook, having six feet fall; passed by making a portage one hundred and ten yards long.

Black Birch and Deer Lakes

We reached Black Birch lake about its middle, and then coasted its shores in an easterly direction for three miles to its outlet. The shores rise from thirty to fifty feet almost perpendicularly above the lake; the trees are larger than those last described, but nearly seven-eighths of the timber has been burnt. Turning north down the outlet, the stream, varying in width from ten yards at the falls and rapids to half a mile, was followed ten miles to Deer lake through a rough, barren and rocky country, almost wholly burnt; chutes of twelve, eight and six feet were passed in this distance, and the entrance of Deer lake was reached on the 18th of June. Here, on a small island, we found the provisions forwarded from Family lake, safely stored.

Having transferred them to our canoes, we continued the survey along the north side of the lake, for nine miles, to the supposed outlet, which, however, proved to be an inflowing stream. As we were without a guide, we were obliged to coast carefully along the shore and around each small bay. Thus the north shore of the lake was surveyed to its extreme end, where, at a distance of forty miles from the supposed outlet, another large stream was found flowing in. Knowing that the chances were greatly in favour of the outlet being on the north side, and thinking that it might have been passed, we carefully retraced the coast for twelve miles, and succeeded in finding the outlet in a small bay. It passed through a narrow cleft in a high rock and was not visible, even when close to its entrance. Deer lake is a long, narrow body of water, surrounded by rocky hills, rising from fifty to two hundred feet above the lake. These hills are rounded, and appear to run parallel to the range forming the height-of-land. The lake runs in a general course of N. 7° E. Its greatest length is about forty-five miles, with a breadth varying from one to four miles. Three deep bays indent its eastern end, the entrances into which are narrow and easily overlooked, unless the shore is very closely followed. The outlet is in the north bay, four miles from its entrance. Besides the bays above mentioned, several large and many smaller lateral bays deeply indent the shores, which are generally steep and rocky, and the lake itself is full of rocky islands rising from its clear waters. The surrounding hills have been almost wholly burnt by fires of various dates, and present all the different appearances of a burnt country, from the standing blackened trunks left by recent burning, to the small second growth of poplar and banksian pine of earlier fires. The soil is very thin, and the timber correspondingly poor, except on a few low points, where some white spruce, balsam and poplar exceed fifteen inches in diameter.

[25] The exploration on which this report is based was made in 1886. The report forms Part F of Vol. II. of the Geological Survey of Canada.



Black Birch and Deer Lakes

The river runs in a northerly direction, with a swift current for one mile, and then expands into a small lake, one mile beyond which it turns sharply to the west and contracts, flowing with a rapid current for five miles between high, rocky banks covered only with dry moss and a few stunted black spruce, birch and banksian pine, all less than four inches in diameter. In this distance there are five chutes, which together give forty-nine feet fall; or sixteen, ten, six, five and twelve feet. Here the river again turns north and spreading out flows with a steady current for eighteen miles to Favourable lake, but interrupted by chutes of three, twenty, and twelve feet and a few small rapids. As the river descends, the surrounding country gradually becomes smoother and the timber larger until within three miles of the lake, when the stream passes through low, swampy land, covered with thick, wet moss and a small growth of black spruce and tamarac.

Favourable Lake

We entered the lake at its south-west corner, and followed the north shore for nine and a half miles to the end of a point; here the lake took a short turn to the northward, and again stretched out east and west. Supposing the outlet to be to the eastward, we surveyed to the end of the lake in that direction seven and a quarter miles, and found two small streams flowing in. Returning to the point, we proceeded westward six miles to a small channel from the north, and discovered that the point was the end of a peninsula about seven miles long, joined to the main shore by a narrow neck of sand, over which a small portage might have been made and fifteen miles of paddling avoided. After passing through this channel one mile, the lake again expanded, and we then followed the west shore nine miles, and found the outlet in the north-west angle, where two bays were seen stretching away to the eastward.

Favourable Lake is very irregular in shape, the two portions forming a T, the stem of which lies north and south, with a crooked head stretching irregularly east and west. The width varies from two to five miles. Hills from fifty to one hundred and fifty feet high surround the lake, more than half the timber on which has been burnt. Along the shores there are considerable areas of good land, the best being on the peninsula and along the southern part of the lake, where the underlying rocks are hornblendic and chloritic schists; the northern portion is more barren, the soil resting on gneiss.

The soil is a fine, rich, sandy, loam, quite suitable for growing good crops, and summer frosts seem to be the only drawback to successful agriculture. These are said not to occur at Trout lake, though situated farther to the north-eastward. The trees around Favourable lake consist of white and black spruce, aspen and balsam poplar, white birch, balsam and tamarac, many of which exceed eighteen inches in diameter.

Sturgeon are plentiful in the lake; it is remarkably free from islands; the water is a dirty light yellow colour and not deep. At the end of the peninsula the foundations of several old houses were discovered, out of which trees twelve inches in diameter were growing. These ruins evidently mark the site of some old Hudson Bay Company, or more probably Northwest Company, trading post. Nothing was known about it at the Hudson Bay Company's post we visited.

Favourable lake was left on the 29th of June, and at two miles due north a fall of eight feet was reached; this fall is formed by a horizontal ledge of gneiss, which closely resembles a mill-dam. Three-quarters of a mile farther on, a portage of seventy-five yards was made to pass a chute of twenty-five feet. Beyond this, the river flows in the same northerly course seven miles, when another chute of fifteen feet was reached.

From here the stream bends gradually westward for ten miles, then turns sharply north for five miles, and again bends slightly north of east for ten and a half miles. Here the river apparently forked; thinking that the north branch, which looked the larger, the correct road, we passed up it and entered a lake, only to find, after making a survey of its shore, that we were once more at the place we entered by, that no other outlet existed, and that we had gone ten miles out of our way. Continuing down the river seven miles due east, a sharp turn to the south was made, and passing four and a half miles along this course, Musk-rat Dam lake was entered.

For the entire distance between Favourable lake and this lake, the river, with the exception of the three falls mentioned, flows with an imperceptible current between low, muddy banks, covered along the edges with grass and weeds, and has an average breadth of two hundred feet. The water is of a whitish-yellow colour, and is highly charged with suspended matter.

Musk-Rat Dam Lake

The surrounding country is a vast, level swamp, broken only by a few knobs of gneiss, that rise from ten to fifty feet above the general surface. The swamp is covered with moss, and supports a small growth of black spruce and tamarac; better timber growing on and around the hills. Musk-Rat Dam lake was entered July 3rd on its north side, some distance from the west end. Owing to the smoky state of the atmos-

phere, and the numerous islands which obstruct the view, neither the west end nor the south shore were seen, and so the exact size of the lake is unknown. We coasted along the north shore to the south-eastern angle, a distance of nineteen and a half miles, passing many islands of various sizes. Where the river enters the lake, it has deposited much of the matter it carries, and formed a long point of low marsh, now covered with grasses and small willows, and surrounding several small, rocky islands; the name of the lake is probably due to this feature. Elsewhere, the shore rises from thirty to seventy-five feet above the water, the greater part consisting of clay and loam soil with several rocky points and outlying islands. The timber, with the exception of that growing on the points and islands, corresponds in size and variety to that described around Favourable lake. The islands, many of which are quite large, are rocky, and covered chiefly with a dense growth of black spruce. Several extensive fires were burning round the lake while we were on it, and the smoke was so thick that it caused considerable delay in the work of surveying.

Sandy Lake

We left Musk-Rat Dam lake at its south-east angle, and followed the river in a S. 30° E. course for four miles to Sandy lake. This lake was also entered on its north side at some distance from the western end, and the shore followed to the eastern extremity, a distance of forty-three and a half miles. This is probably the largest body of water passed through on the route, its extreme length and breadth being unknown, as the surface is covered by innumerable islands, so close together that a view of the opposite shore could not be had.

The water is turbid and white in colour. The shore is higher and more rocky than that of Musk-Rat Dam lake, but much good land, and many trees of white spruce, poplar, birch and balsam were seen, exceeding eighteen inches in diameter. Indeed, the greater part of the land around these lakes would make good farms.

Severn lake lies north-east of Sandy lake, and distant from it one hundred and fourteen miles by the river. Sandy lake was left on the 8th of July. The river passes with a sluggish current between low hills, mostly burnt; and at six and three-quarter miles, a chute of eighteen feet was passed by a portage one hundred and fifty yards long. Beyond this, the river becomes narrow and crooked, with a swift current, passing low, rounded and rather rocky hills, with good soil between, supporting a growth of black and white spruce, tamarac, poplar and birch, slightly smaller than those seen around the lakes.

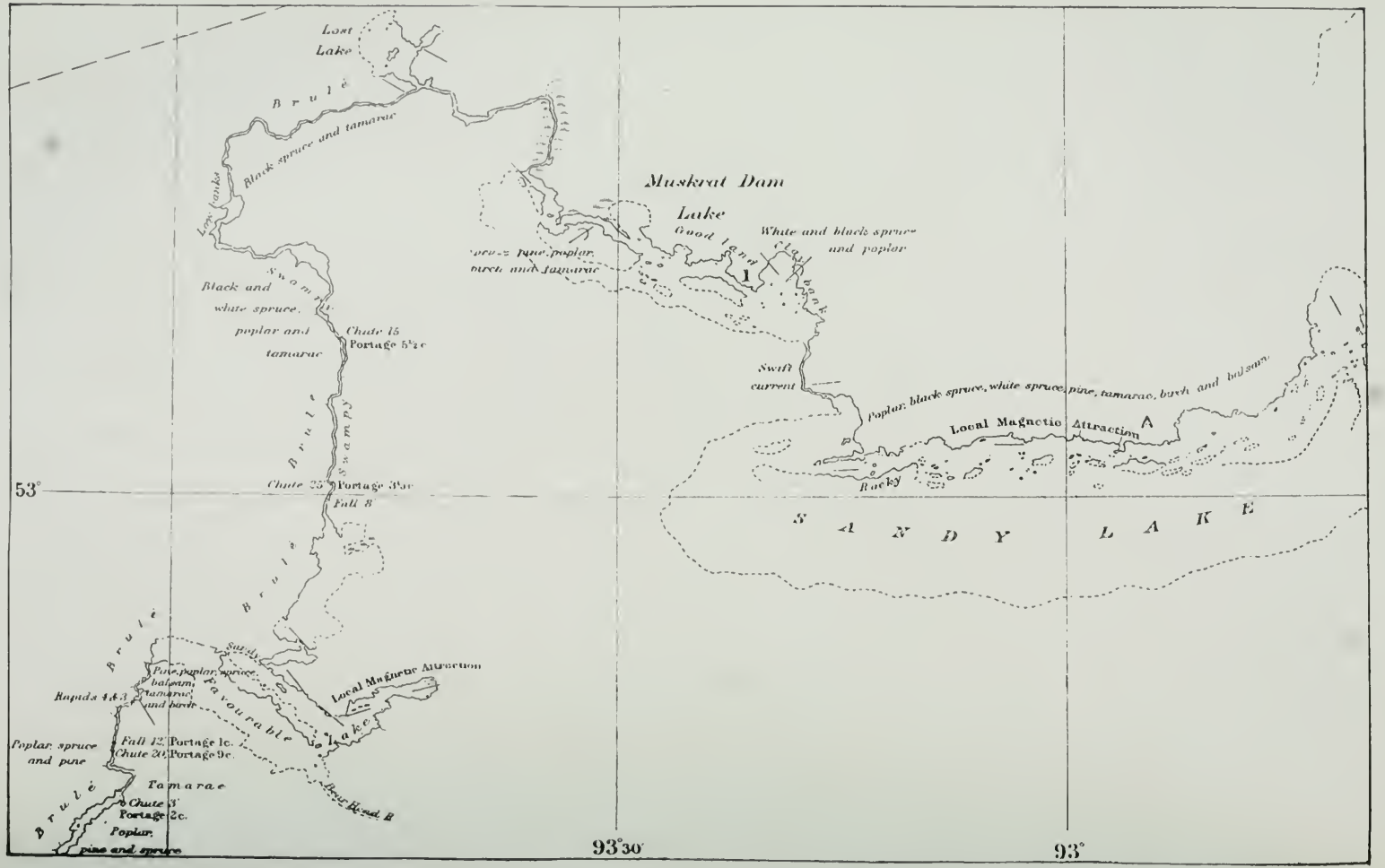
Forty-two miles from the portage, the river widens out into two lakes, which, together, are sixteen miles long and not above two miles broad, both being dotted with many small islands. The surrounding country is almost flat, with good timber and soil. Beyond this, as far as Severn lake, over 114 miles north-east from Sandy lake, the river flows with a swift current, broken by several rapids and falls, entailing six portages.

Cut banks, from five to ten feet high, composed chiefly of a boulder-clay, are now seen. The soil and timber become poorer, and good trees grow only on the islands, the shore having a thick growth of black spruce, poplar, and tamarac of small size.

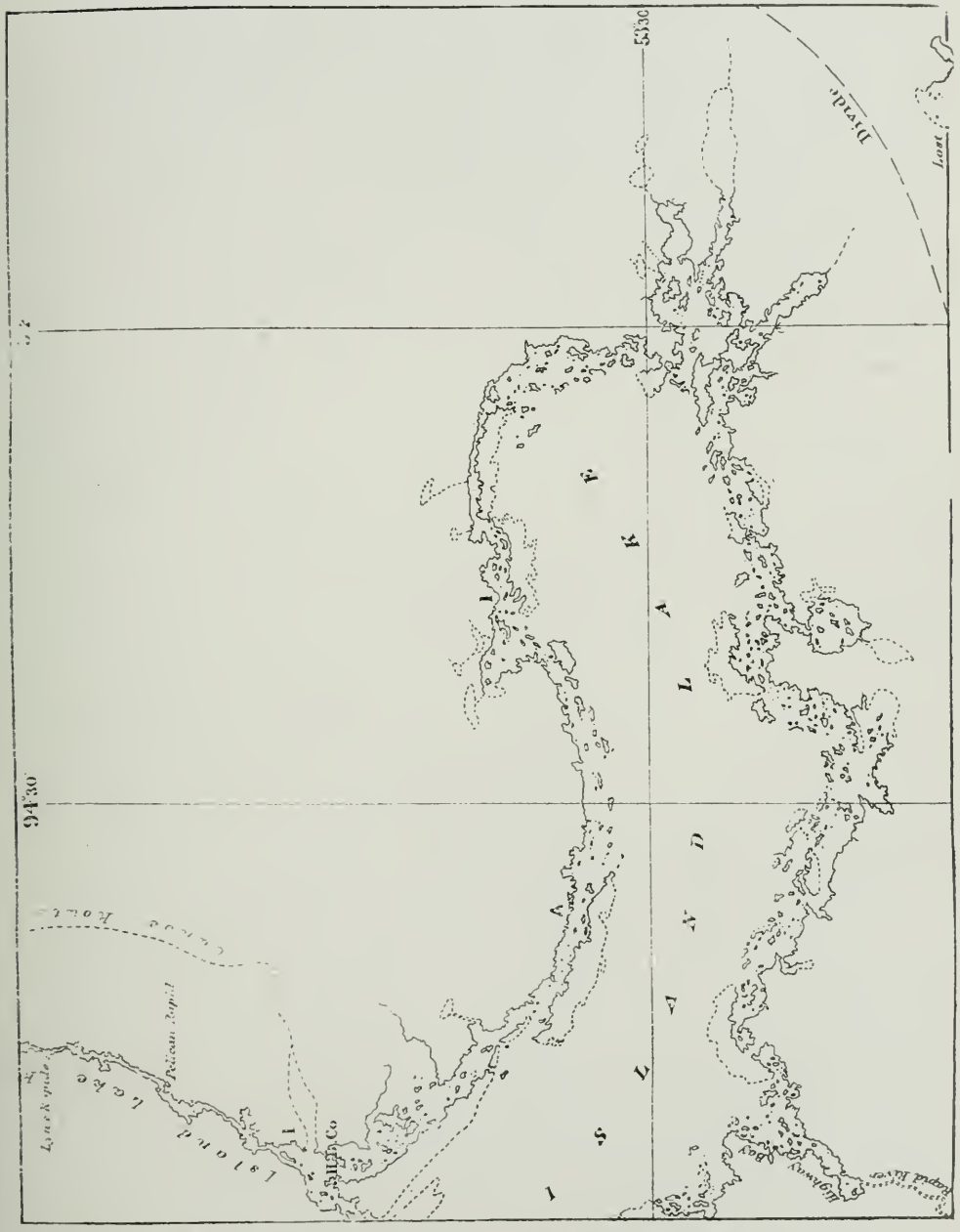
Severn and Trout Lakes

While camped on the last portage above Severn lake, an old Indian with his wife passed in a canoe, the first persons seen since leaving Family lake. As we had but an imperfect idea of our exact position we hurried after and overtook them on an island in the lake, and learnt that we were on Severn lake, and that, by a portage route, the Hudson Bay Company's post on Trout lake was distant about three days' journey. As our provisions were running short, not enough remaining to carry the survey to the mouth of the river, we decided to make for Trout lake. Accordingly, we crossed the lake in a south-east direction, and in nine miles reached the portage.

The shores and the numerous islands of Severn lake are all low and swampy, covered chiefly with black spruce and tamarac. The portage by which the height-of-land between the Main and Fawn branches of the Severn river is passed, is one and a quarter miles long, through low, swampy ground, with a rocky ridge at the east end. Here a small lake and another portage of 400 yards brought us to three small lakes, connected by a small stream; leaving the stream at the third lake, three portages of 350, 760 and 375 yards, are passed with two intervening small lakes, the stream being again reached at the end of the third portage. Descending it two and a half miles Little Trout lake, four miles long by one broad, was entered and passed through to its east end. Following its outlet four miles, Trout lake was reached July 19th. The general course of the route was due east, through low, swampy country, out of which rise a few low, rocky hills almost destitute of soil, the whole covered with small trees of black spruce, banksian pine and tamarac, few exceeding six inches in diameter two feet from the



Favourable, Musk rat Dam and Sandy Lakes



Island Lake on Manitoba boundary, about twenty miles northwest of Musk-rat Dam Lake.
A—Keewatin (and Huronian?). 1—Laurentian.

ground. Trout lake is irregularly oval in shape, forty miles long from east to west, and nowhere more than twenty miles wide. Its shores are generally low and swampy, with some rocky points, the highest land being towards the west and south. Along the north side, are several large islands and numerous smaller, rocky ones. The prevailing trees are black spruce, with tamarac, aspen poplar, white spruce and birch, a few being eighteen inches in diameter.

[Since two of the largest lakes in the district of Patricia are known under the name of Trout, the alternative name of Fawn has been used for the lake on the Fawn branch of the Severn river on the map which accompanies this volume.—*W. G. M.*]

The water of the lake is remarkably clear, cold and deep, and is abundantly stocked with large white fish and lake trout, which form the principal food of the Indians and Hudson's Bay Company's people living around the lake.

The Hudson's Bay Company's post is situated on one of the larger islands, twelve miles from the east end. Here also is a church, supported by the Church Missionary Society of England, and the services are conducted by a native missionary.

Nearly 500 Indians trade at this post, but they do not all belong to the post, part being a roaming population, some of which belong to Martin's Falls and Cat lake posts, on the Albany river, while others come from York, Severn and Island lakes. These Indians speak a language made up chiefly of Cree words, with a mixture of Sautaux dialects; they are all supposed to be Christians, although many of them still believe in the power and charms of the medicine men.

Crops at Trout Lake

Mr. Tait, the officer in charge of the post, says that good crops of peas, potatoes and other roots are raised here yearly, and are very rarely injured by summer frosts. This being the case, the country to the westward, between Severn and Sandy lakes, which is more favorably situated, having all the appearance of a better climate and a richer soil, must undoubtedly be well suited for agriculture, and will at some future time prove valuable land for settlement. At the Hudson Bay post both our canoes were repaired; and on the 22nd July, after securing the necessary provisions for the trip to the mouth of the river, and having determined the latitude of the place, we proceeded along the north shore to the north-east corner of the lake, where the Fawn branch of the Severn river flows out.

Fawn Branch of Severn River

This river, which varies from thirty to six hundred yards in width, was followed for eleven miles due north, where a small lake, three miles wide, was crossed. From here, for fifty miles, the river, with an average breadth of thirty yards, flows N.N.E., with a rapid current between low banks. Twenty-four rapids and chutes, caused by ledges of gneiss crossing the stream, occur in the distance, the greater number of which have to be passed by portages in ascending the stream, although only eight were made in descending.

At the rapids the river usually spreads out, and flows in several shallow channels, between a number of small islands. This greatly increases the danger of damaging the canoes from striking against rocks on the bottom while running down stream. In its upper part the channel is greatly obstructed by large boulders strewn over the bottom, often rising to within a few inches of the surface, a good look-out being necessary to keep clear of them where the current is slow, as there is then no sign to show their position.

Throughout this distance the surrounding country slopes towards the north and east with the river, which flows but a few feet below the general surface. Except the few small ridges of gneiss, the whole is swamp, covered with thick, wet moss, and supporting a growth of small black spruce and tamarac with a few poplar clumps.

On the islands is a better growth of white and black spruce, poplar and tamarac; the last white birch was seen near the end of this course. This region has a bleak, barren look, with soil totally unfit for cultivation, being wet without the possibility of drainage. Below the last chute the character of the river changes; it now flows with a swift current between banks cut in the drift sands and clays, but no rapids necessitating portages occur until within a few miles of the Forks.

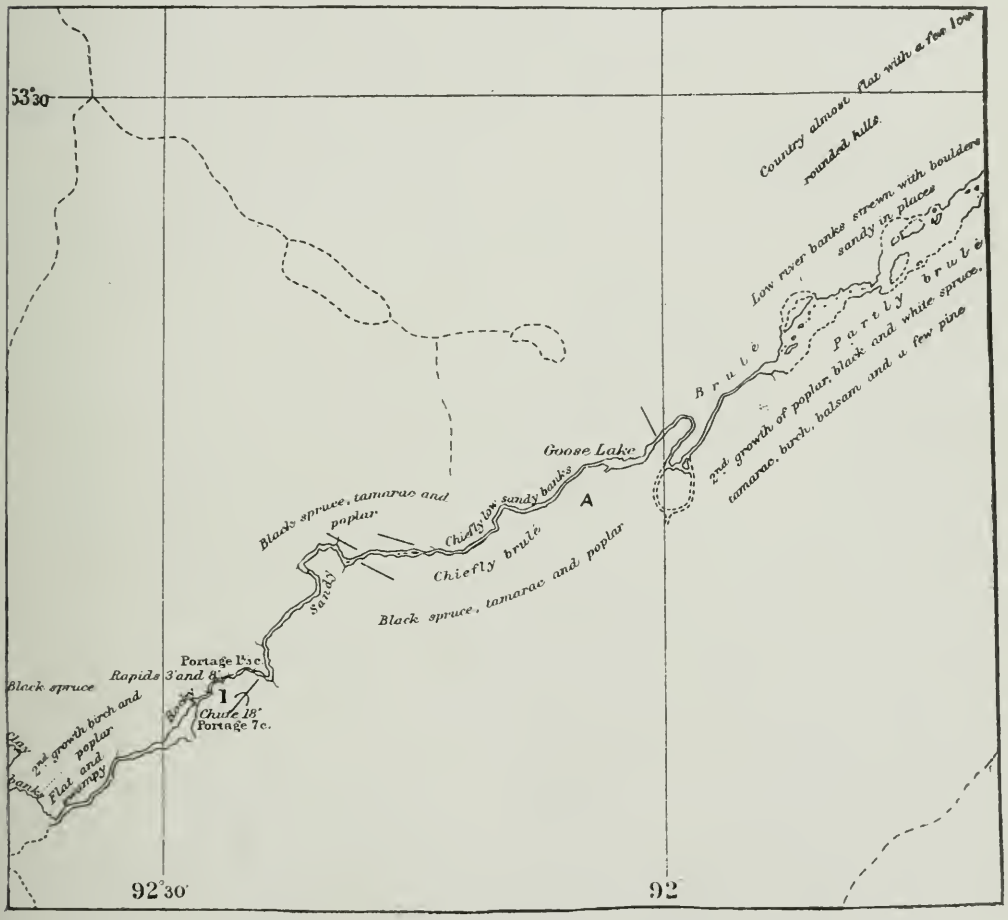
The country above the river valley is comparatively flat and swampy, with clay subsoil overlaid by sand; the trees are chiefly black spruce and tamarac of small size, the greater part of which have been burnt. These characteristics prevail all the way to the mouth of the river, the whole country being practically useless.

The only timber large enough for small buildings grows on the islands and in the bottom of the river valley, where the soil is better and the high banks form a protection from the cold winds. Below the last chute the river first runs N. 50° E. for seventeen miles, then in a general course a few degrees south of east, twelve miles, to the Otter

river, a large branch flowing from the southeast. For this distance the sloping banks of the river vary from ten to fifty feet high, and are covered to the water's edge with a thick growth of small willows.

Below the Otter branch the river suddenly expands, being almost fifty yards wide, and gradually increasing with the descent; the channel is very shallow and interrupted by a great number of bars. The water, which on leaving Trout lake was remarkably clear, gradually becomes discoloured by the washing down of the clay banks of the river and the dirty waters of small brooks that flow in.

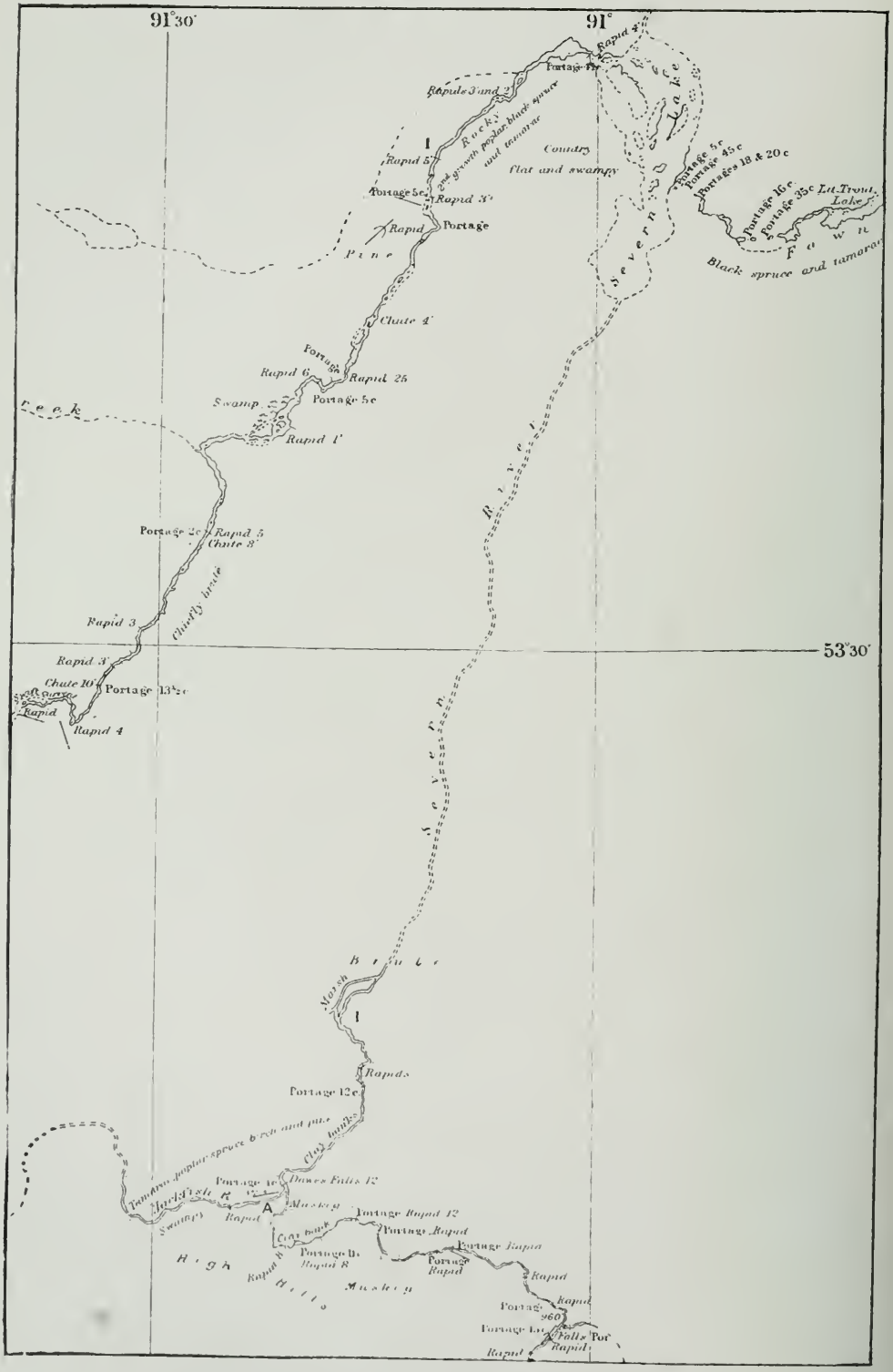
The valley now becomes deeper, the banks rising from fifty to one hundred feet, the upper part being cut almost perpendicular, with the lower part sloping gradually to the water's edge.



Part of Severn River between Sandy and Severn Lakes.
A—Keewatin (and Huronian?). 1—Laurentian.

The willows do not grow so thick along the banks, which afford good tracking paths, used by the Indians in towing the boats up stream. Marks on the trees along the banks show that in spring the ice passes along fully fifteen feet above the summer water level.

From the Otter river the general course is about northeast for thirty-eight miles, then N. 30° E. twenty-one miles to the Picticiow river, flowing in from the eastward. Here a turn is taken westward, and the stream passes from bank to bank in a valley about half a mile wide, with a general course of N. 35° W. for fifty-six miles to the forks of the Severn. Six miles above this point beds of limestone rise from under the clay banks, and in crossing the stream cause several heavy rapids.



Part of two branches of Severn River, and Severn Lake.

(See Appendix II, page 200, for Geological Legend and Symbols.)

Junction of Fawn River and Severn

The Severn river, below the junction of the Fawn, is about half a mile wide. Beyond this, as far as its mouth, it varies from one-quarter to one mile in width, the average being one-third of a mile. The cut banks are from thirty to two hundred feet high, gradually falling as the sea is approached. The channel is very shallow, and in places greatly obstructed by low gravel beds and sand bars. From the forks the general course is N.E. for 16 miles, then 10° E. for twenty-three, where a fall of thirty feet, called the Limestone rapid, occurs in one mile. This is caused by beds of limestone crossing the stream, forming a number of small islands, between which the river pours in heavy rapids.

The portage by which this obstruction is passed is on the west bank and over the bare limestone rock.

Besides this rapid there are several smaller ones, due to the same cause, but none are heavy enough to necessitate portages.

Below the Limestone rapid the river again flows north-east to the sea, a distance of twenty-eight miles. Many large islands divide the stream into different channels for several miles from its mouth.

We arrived at Fort Severn, situated on the west bank about four miles from the sea, on the 6th of August, thus finishing the micrometer survey from Lake Winnipeg to Hudson bay.

Fort Severn

Fort Severn is a small trading post of the Hudson Bay Company, resorted to by a few Indian families, the majority of whom live along the coast, making their hunts on the small rivers flowing into the bay, and living chiefly on geese, which are killed in great numbers in the spring and fall while on their way to and from the breeding grounds of the north. The soil around the post is a heavy clay and very swampy. The climate is so cold and the season so short that nothing but a few small turnips is grown here. On August 8th we picked strawberries on the clearings around the post; at that time they were only beginning to ripen.

It was the intention to return up the river to Severn lake, from there to go by Trout lake across the height of land to Cat lake, and thence to Rat Portage; but on reaching Fort Severn the canoes were found to be so worn out as to make it impossible to return in them, and being unable to procure anything suitable for the trip at Fort Severn, we were obliged to coast along shore to York Factory.

This we attempted to do in our canoes, and, leaving Fost Severn August 10th, in two days we reached Goose river, forty miles on the way. Here we were delayed by a heavy gale from the north-west, which continued for three days. On the second day a violent gust lifted the larger canoe over the stakes driven in the ground to secure it, and, rolling it over the ground, threw it against one of the tents, breaking it beyond repair. I immediately sent Mr. Macoun, with one man on foot, back to the post, with a request to send a boat and men enough to take us to York. They returned on the third day with a small whale boat and two Indians as guides.

Embarking, we coasted along shore, being greatly delayed by head winds, and reached York Factory on the 23rd August, without other accident than the loss of our other canoe, which broke adrift from the boat while anchored off one night in a gale.

Fort Severn to York

The distance between York and Severn is about 200 miles. The coast is quite flat and low, and is formed, for a considerable distance back from high-water mark, of parallel ridges of gravel, from one to four hundred yards apart, the space between being filled up with sand and mud, and dotted with innumerable small lakes or ponds, the water of which is brackish behind the outer ridges, but quite fresh, clear and cold farther inland.

These ridges are each a few inches higher than the next nearer the sea, and drift wood is seen on each, showing more signs of decay on the inner than on the outer banks.

This would tend to show that in this part of Hudson bay the shores are slowly rising, as has been noted by other observers on other portions of the northern coasts.

The ebb and flow of the tide is between four and six feet. At low tide the water retreats a long way, exposing great sand and mud flats, with gravel ridges, mostly parallel to the shore, and in many places thickly strewn with large boulders. From the mouth of the Severn to near Cape Tatnam no trees are seen from the shore; beyond this small black spruce come to within a mile or so of the water. The distance of the trees from the shore is due to the unfavorable soil rather than climatic influences. Between high water and the tree line the sand and gravel are almost bare, while the mud between the ridges is covered with a rich growth of grasses, affording fine feeding grounds.

Trout or Fawn Lake on Severn River.

A—Keewatin (and Huronian?). 1—Laurentian.

Being unable to obtain canoes at York, we were obliged to travel in a heavy, flat-bottomed boat. Leaving York August 26th, Norway House, the head of Lake Winnipeg, was not reached until September 20th, great delay being experienced owing to the low state of the water in the Hayes river and its branches. At Norway House our boat was exchanged for a lighter one, in which we coasted down the east shore of Lake Winnipeg, but were so delayed by rough weather that Selkirk was not reached until October 13th and Ottawa four days later.

GEOLOGICAL NOTES

Archaean

(A) Laurentian

With the exception of some small bands of Huronian, the Laurentian rocks occupy the whole area of country between Lake Winnipeg and Trout lake, and probably extend much farther to the eastward.

Their northern limit on the Fawn river was not exactly located, the rocks being covered with drift, but it lies somewhere between the last chute on its upper portion and the limestone exposures near the forks; from the physical features of the valley it is supposed to be near the former point. The rocks consist chiefly of the characteristic red micaceous gneiss, along with grey varieties, and also hornblendic gneisses. No limestones were noted.

(B) Huronian

The Huronian rocks were first observed on Favourable lake, where they consist of chloritic and altered hornblende rocks, with talc and hydro-mica schists. The same band, presumably, was seen on Sandy lake, and below it on the Severn river. The rocks in several places are highly magnetic, and probably contain large quantities of iron ore, both disseminated in small crystals through the rock and in large masses. Another band was met with at Trout lake, in connection with a large mass of eruptive rocks.

[Under the nomenclature now in use the rocks classed as Huronian in this report should be called Keewatin.—*W. G. M.*]

Owing to the extent of the country covered in one short season, no strict investigation of these rocks could be undertaken, and it remains for another season to examine them carefully, both as regards their mineral characters and lithological relations.

Palaeozoic

Cambro-Silurian and Silurian

The limestones of the Severn and Fawn rivers, as roughly determined from the fossils collected, are not older than the Galena, and may be as new as the Niagara; more investigation, however, is required to fix their precise horizon.

The rock is a coarse, yellowish-white dolomitic limestone, closely resembling that of Lake Winnipeg. It lies almost flat, being broken only by long, low anticlines and synclines. At the Limestone rapids of the Severn, where it is more contorted than usual, it rises in a number of low domes, closely resembling a sheet of letter paper when dampened. The total thickness of the beds exposed does not exceed one hundred feet.

Post Tertiary

Drift

From Lake Winnipeg to Hudson bay almost all exposed rock surfaces exhibit distinct evidence of ice action, being strongly marked with glacial striæ, which vary in direction but a few degrees on either side of north-east, showing that the drift was from that quarter. Scattered all over the surface of the country are rounded boulders, many of great size and evidently far-travelled.

The Severn and Fawn rivers for over two hundred miles from their mouths have cut valleys into the Post Tertiary deposits. As seen in the banks of these streams, where sections of two hundred feet are obtained, the top beds are composed of a light, sandy clay, containing many boulders of limestone, gneiss, red jasper and green chloritic and epidotic rocks. Below these are thin sandy beds, holding a large number of small boulders; while the lowest and thickest beds are made up of a heavy blue clay, comparatively free from boulders.

The following fossils were collected on the Fawn river, a short distance from the forks:—

Rhychonella psittacea, Chemnitz.
Cardium Islandicum, Chemnitz. (= *C. ciliatum*, Fabr.)
Macoma calcarea, Chemnitz.
Mya truncata, L.
Saxicava pholadis, L. (= *S. rugosa*, Low.)
Buccinum tenue, Gray.
Trophon clatheatus, L.
And a small *Balanus*.

Botanical Notes

It has been deemed inadvisable to publish with this report a list of the plants collected, as many species will probably be added during the next season, and after the country has been thoroughly explored a complete list will be published. A number of species was collected that were new to this portion of Canada, and a few that are extremely rare. Among the most interesting may be mentioned *Aquilegia brevistyla*, Hook, in two localities on the Severn river; *Nymphoea odorata* Ait. *Var. minor*, Sims, growing in profusion between Severn and Trout lakes. *Sisymbrium humile*, C. A. Meyer, was found a short distance from the junction of the Fawn and Severn rivers, growing in gravelly soil; and along the coast, between Fort Severn and York Factory, specimens were collected of a species supposed by Watson to be *Sisymbrium humifusum*, Hook, and has been so named provisionally by him. This species has not been found before on this continent, although reported from Greenland.

A peculiar form of *Linum perenne*, L., with white flowers and of procumbent habit, was noted in one locality along the coast. Although supposed to be rare, *Saxifraga Hirculus* L., grew in great abundance between Severn and York. Three specimens of *Cnicus Drummondii*, Gr. *var. acaulescens* Gr., were collected along the Lower Severn, not before noticed east of the Saskatchewan.

Chrysanthemum arcticum, L., and *Matricaria inodora* L. var., *nana*, grow as far south as the mouth of the Severn. A form of *Primula*. that appears to be intermediate between *P. farinosa*, L., and *P. Mistassinica*, Mx, but placed by Watson with the latter species, was found growing along the coast below high-water mark. *Scheuchzeria palustris. L.*, is of frequent occurrence throughout the country. *Arctophila Laestadii*, Rupt., a rare and beautiful species of grass, recorded but once before, is quite common along the coast.[26]

[26] The appendix to the report from which the foregoing paragraphs are taken gives five pages of meteorological observations made by Mr. Low and his assistants during the trip from Lake Winnipeg to Hudson Bay.—W. G. M.

Boulder of green and reddish purple Slate, Winisk river. Photo by W. McInnes.

REPORT ON

A PART OF THE NORTH-WEST TERRITORIES OF CANADA DRAINED BY

THE WINISK AND ATTAWAPISKAT RIVERS[27]

By William McInnes

The present report deals with a tract of country lying within the unorganized North West Territories of Canada, between N. lat. 51° 10′ and N. lat. 55° 10′, and between W. long. 86° and W. long. 90°.[27a]

This district forms part of what was known for a time, prior to the inauguration of the Provinces of Alberta and Saskatchewan, as the District of Keewatin, and lies between the northern boundary of Ontario and the south-western shore of Hudson bay.

It is drained by rivers running from the west into James bay and into Hudson bay respectively, and the report is, in the main, a description of one of the latter—the Winisk—throughout almost its entire length, and of the upper branches of one of the former, the Attawapiskat.

Earlier Exploration in the District

As far as I have been able to learn there are no references in the journals of the early explorers to the Winisk river. All concerned in the search for a north-west passage to the Orient, they were naturally led to give most of their attention to the passages between the Arctic islands lying at the extreme north end of the bay. The mouth of the Severn river was, however, visited by a number of them, and Henry Hudson and Thomas James explored the bay now known as James bay, then called Hudson's bay.

Captain Thomas James and Captain Luke Foxe (who styles himself in his journal the "north-west fox"), seem to have been the only navigators who sailed along the coast between the Severn river and Cape Henrietta Maria, for the purpose of examining it. They describe a generally low shore, with shallow water, and make no allusion to having noticed the mouth of the Winisk river. It must have been, however, as Mr. Miller Christy points out, in the vicinity of the bay at the mouth of the Winisk river that the two vessels approached one another in August, 1631, when the two captains, both bearing letters from His Majesty King Charles I to the Emperor of Japan, were able to compare notes as to their discoveries, and when Captain Foxe, ridiculing James' action in keeping his flag continually flying at the masthead, said to him, to use the quaint language of his journal, "Keepe it up then," quoth I, "but you are out of the way to Japan, for this is not it."

Mr. G. Taylor, of the Hudson's Bay Company's service, seems to have visited the river in 1808, and to have supplied the topographical details that appear on the Arrowsmith map.

Dr. Robert Bell, in 1886, descended the Attawapiskat river from the lake, which he named Lansdowne, to the sea, and published an account of the exploration in the Annual Report of the Geological Survey for that year.[28] The Fawn branch of the Severn river was explored by Dr. A. P. Low in 1886[29], and the Ekwan and Trout rivers by Mr. D. B. Dowling and Mr. W. H. Boyd in 1901.[30] No description of the Winisk has been published, though, without doubt, employees of the Hudson's Bay Company have traversed it, as, in the early part of the last century, posts of the Company were established at three points near the head of the river. The missionary priests from Albany, too, have descended the river, holding missions at the more important Indian centres.

Surveys

In order to secure data for the compilation of a map of the region, the following surveys were carried out during the seasons of 1903-4-5:—

Surveys by micrometer telescope and compass, checked by astronomical observations for latitude, were made of the Winisk river, from the mouth to a point 190 miles from the coast, following the course of the stream; from the foot of Wunnummin lake up to

[27] This report, No. 1080, is based on surveys made for the Geological Survey of Canada in the seasons of 1903, 1904, and 1905. Preliminary or summary reports accompany Vol. XV., part AA, pages 100-108, and Vol. XVI., part A, pages 153-160, of the Geological Survey.

[27a] As will be seen from the map, scale 35 miles to 1 inch, accompanying this volume, the part of the territory described by Mr. McInnes' report now lies wholly within the District of Patricia. W.G.M.

[28] Annual Report Geological Survey of Canada (New Series), Vol. II., 1866, Part G.

[29] Ibid. Part E.

[30] Summary Report Geological Survey of Canada, 1902.

the outflow of the west branch at Misamikwash lake, a distance of 60 miles; down the west branch for 55 miles, and across by a portage route 24 miles in length to Trout lake at the head of the Fawn branch of the Severn river; of a route from the foot of Lake St. Joseph by way of the south branch of the Attawapiskat river to Fort Hope, a distance of 189 miles; and of 27 miles of the Albany river below Fort Hope.

In addition to the above a number of track surveys, checked by latitudes, were made. These covered portions of the Winisk river; part of the Attawapiskat river; three routes connecting the Attawapiskat and Winisk rivers; a route from the Albany river at Eabemet lake to Lansdowne lake; and a route from Trout lake down the west branch of the Winisk river and across to the main river near Nibinamik lake.

Routes into the Region

While the number of possible routes to the Albany river from the Canadian Pacific railway is very great, there are but three that have been used to any great extent, one leaving the railway at Dinorwic station and reaching the Albany river by way of Lac Seul and its tributary the Root river, another one strating from Ignace and reaching the Albany by way of Sturgeon and Musibimega lakes, and another leading from Nipigon station by Nipigon river and lake and crossing to the Albany by way of the Ombabika and Opichuan rivers. The first of these is the best route in, particularly where a load is to be carried, as, though somewhat longer than either of the others, it is down stream or through large lakes for the greater part of the distance.

For light canoes and a quick passage the route by way of Nipigon is preferable, on account of the shorter distance to be traversed.

The greater part of the supplies used for the fur trade in the district are brought up the Albany river from James bay, a route including 300 miles of swift water, where tracking is the only means of progression, and about 50 miles of alternating quiet water and rapids, where portages are frequent. This is considered an easier route to Fort Hope, the headquarters of the trade, than any of the roads from the Canadian Pacific railway.

The completion of the Grand Trunk Pacific railway will shorten very considerably the distance from this side, and render the whole region comparatively easy of access.

From Fort Hope the heads of the Winisk and Attawapiskat rivers can be reached by several routes, none particularly difficult, but all made tedious by reason of the number of portages necessary.

General Description of the Region

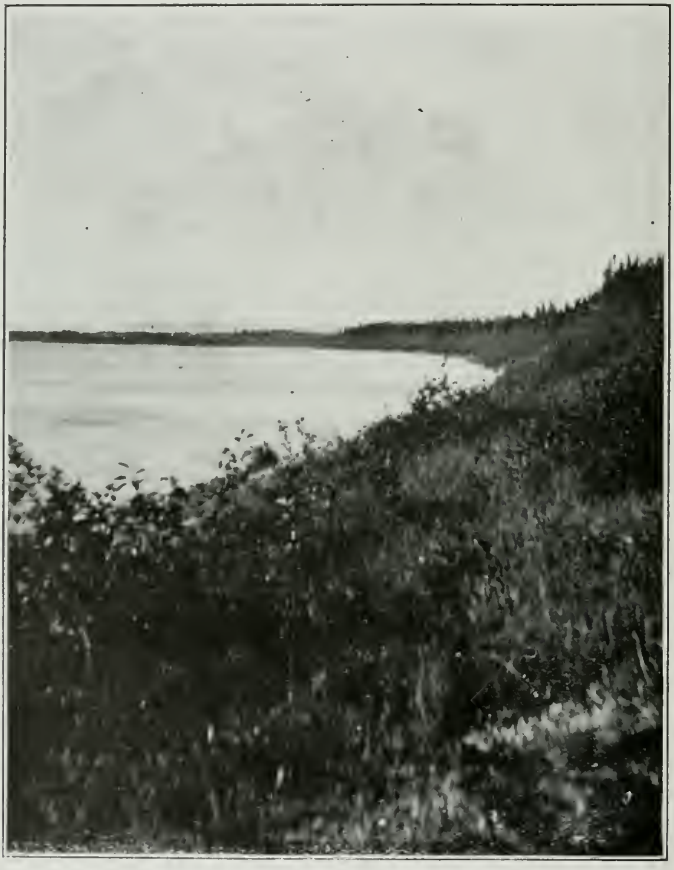
The region may be roughly divided into three great areas, each with characteristic features: the Archæan area of the high interior plateau; the boulder clay area; and the limestone area of the Hudson bay basin. The Archæan, of the three, comprises by far the largest extent of country.[30a] It consists of an elevated, undulating plain, with an average height of from 700 to 1,000 feet above sea-level. The effects of long-continued subaerial decay and denudation, supplemented by the later cleaning up and smoothing action of a great glacier, are everywhere noticeable in the gently rounded outlines of the very moderate elevations. On it all the larger rivers of the Hudson bay watershed, and many of those flowing south and west, have their sources, the great muskeg areas acting as storage reservoirs, from which, even in the dryest season, the volume of drainage is large. It is along the parts of their courses lying within this area that the quickest descent occurs, falls and rapids that would afford water-powers being thus largely confined to the upper stretches of the streams. This condtion is in contrast with that obtaining everywhere throughout eastern Canada, where the streams flow for the greater part of their length over the Archæan, and only come tumbling down from the elevations when low down in their courses, after they have attained almost their maximum volume, thus making the eastern portion of Canada probably unequalled in the world in the matter of water-powers. It must not be thought, however, that throughout the area now under consideration there is any scarcity of good water-powers. They occur in great number, but owing to the distribution of the Archæan highland referred to, they are situated mainly far inland rather than near the coast.

Though, considered as a whole, the central, elevated region cannot be spoken of as generally adapted for agriculture, there occur basins covered by heavy deposits of stratified sand and clay that seem to have been laid down in lakes held in between barriers formed by the walls of the retreating glacier and ridges of drift. An examination of some of these clays by Dr. Hoffmann shows them to be highly calcareous and somewhat siliceous, a composition that, with the admixture of the surface vegetable mould, should produce an excellent soil for general agriculture. The question of climate, which is, of course, of the utmost importance when considering the agricultural

[30a] See map page 5

possibilties of a district, will be referred to more particularly in another place. It may be said here, however, that the climatic conditions are, if somewhat adverse, not by any means prohibitory to the general cultivation of suitably situated tracts.

Muskeg, alternating with low ridges of gravel and boulders, covers wide tracts, though, owing to the fact that the only practicable mode of travel through the country is by canoes, there is a tendency, perhaps, to overestimate the extent of such areas, as the natural canoe routes must follow the watercourses, and these in turn keep to the lowest elevations, and, therefore, show a proportion of swamp that is greater than the average of the district. It was noticed that the surface drainage became more perfect in that part of the region extending westerly towards Trout lake. Ascending the Winisk river from Weibikwei lake towards its headquarters this was very noticeable, the muskeg areas becoming infrequent and of smaller extent.



Lower Winisk river Photo by W. McInnes

The larger lakes throughout the district are confined to the Archæan area. They are all comparatively shallow, and so studded with islands, and broken by long, projecting points, that they seldom show any large expanses of open water. They occupy depressions in the superficial deposits, generally with a boulder clay bottom, and in no case was one found occupying a regular rock basin.

The areas of the principal lakes are approximately as follows:—

Wunnummin lake	60	square miles.
Weibikwei lake	40	"
Lansdowne lake	38	"
Ozhiski lake	25	"
Wapikopa lake	24	"
Eabemet lake	20	"
Nibinamik lake	10	"

The highest land lies about the headwaters of the south branch of the Attawapiskat river, east of Cat lake, where an elevation of probably 1,500 feet above the sea-level is reached.

The approximate heights of the principal lakes determined by barometric measurement is given below:—

Eabemet lake, Albany river	900	feet	above sea-level.
Ozhiski lake, Attawapiskat river	910	"	"
Lansdowne lake, Attawapiskat river	815	"	"
Wimbobika lake, Attawapiskat river	1300	"	"
Weibikwei lake, Winisk river	670	"	"
Wapikopa lake, Winisk river	750	"	"
Nibinamik lake, Winisk river	785	"	"
Wunnummin lake, Winisk river	830	"	"
Misamikwash lake, Winisk river	865	"	"

Boulder Clay Area

The tract referred to as the boulder clay area consists of a broad belt of country, about 159 miles in width, lying between the Archæan highlands and the edge of the limestones of the basin of Hudson bay, overlapping the latter, however, so that the surface features of the two are generally quite similar.

Gently undulating, and with a slight slope northerly and easterly, its general surface aspect is that of a great swamp, sparsely covered with stunted and deformed trees, that reach a growth approaching their normal only along the immediate banks of the rivers, where drainage is afforded by frequent short gullies into the trenches that constitute the river valleys. The interior, to within a chain or two of the river-banks, owing to the impervious character of the till, is quite undrained, and consequently covered by a thick deposit of sphagnum moss from two feet to ten feet deep, the surface layer still growing, and even the bottom only bleached a little, but not at all oxidized. The short cool summer season, and consequent low temperature of the water that saturates the moss, is probably the principal reason for the absence of any of the visible effects of decay.

The rivers flowing through this region have no real valleys, that is to say, they occupy trenches but little wider than the immediate channels in which they flow, cut down through the stiff, tough till, which stands up in nearly vertical walls that rise from the freshet mark on either side. At low stages of the water a slanting beach, often paved with boulders, slopes gradually from the foot of the bank to the edge of the diminished channel. A more or less continuous layer of marine clay, rich in fossil shells, overlies the boulder clay, ensuring, wherever it is present, a soil of good quality. The absence of other than swamp vegetation must be ascribed, then, to the almost total absence of drainage, and to the generally unfavourable climatic conditions.

Silurian Limestone Area

The third area, underlain by Silurian limestones and dolomites, presents essentially the same surface features as the till area. The folding of the limestones, however, though generally amounting to broad undulations only, gives to it somewhat more of relief, and the troughs in which the rivers lie have been excavated entirely through the mantle of till, and have cut down into the limestones to depths of from twenty to thirty feet.

There is the same absence of any vegetation other than that having a muskeg habitat, excepting on the islands in the rivers and along their banks.

The northern rim of this area consists of a treeless plain, bordering the shores of the bay, and varying in width from a mile and a half to three miles. It has an elevation of only a few feet above the level of high, spring tides, and is probably submerged on occasions, when these tides happen to coincide with north-east storms on the bay. The sandy and gravelly surface is sparsely covered with bunchy grasses, and, early in August, was bright with the flowers of many sub-Arctic plants, among which the Arctic daisy, *Chrysanthemum arcticum*, the yellow ragwort, *Senecia pallistris*, the painted cup, *Castelegia pallida*, a live-for-ever with small, bell-like blue flowers, purple vetches, and the large rose-coloured *Epilobium* were prominent.

Geological Summary

The geological divisions recognized in the region under consideration consist of the following, in ascending order:—

Laurentian,
Keewatin,
Lower Huronian (?),
Silurian (Niagara),
Pleistocene (Till, etc.),
Post-Pleistocene (Marine clays, etc.).

Laurentian

Biotite granite gneisses, varying in the proportion of their various constituents, in their attitude, and in the degree to which the gneissic structure has been developed in them, are widespread over the whole extent of country explored. Over great areas they have a stratiform appearance, the foliation showing an almost horizontal structure, with only very low, broad undulations. As at present constituted they, without doubt, include areas that differ widely in age, the comparatively new granites, however, occurring in quantity quite insignificant in comparison with the volume of the older gneisses. Pegmatites, in veins and irregular masses, cut the gneisses practically everywhere, and are, probably, though newer than the gneisses, almost contemporaneous with them in their present form.

Keewatin

The Keewatin bands, made up of areas of basic rocks, in the main diorites, diabases, and chloritic and hornblende schists, but including a considerable volume of coarse conglomerates, though occurring as belts of considerable length and four to six miles in width, are of exceedingly small volume when compared with the whole extent of gneisses in which they are enfolded. Probably not more than a tenth of the whole Archæan area is occupied by them.

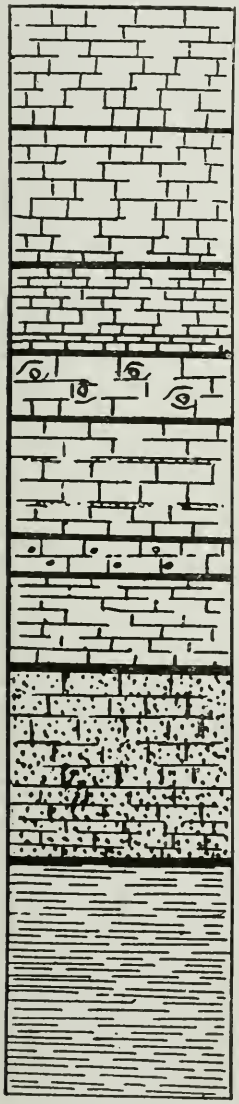
Silurian Limestone on the Lower Winisk river. Photo by W. McInnes.

In the region explored, between the Albany river and the overlap of the mantle of till, six apparently separate belts of these rocks were noted. They have all, in a general way, about the same trend, N. 70° E.

The belt of these rocks crossing the Albany river at Petawanga lake, and seen again on the route between the Albany and Fort Hope, just north of Eabemet lake, is the most southerly. It is made up for the most part of chloritic, feldspathic and hornblendic schists, and diorites in different stages of deformation, and has a width of about six miles. The gneisses bordering the belt on the south are finely foliated, hold a large proportion of black biotite, and are, in certain layers, thickly spotted with garnet crystals. Masses of coarse pegmatite, cutting these gneisses, hold crystals of mica up to 2″ in diameter.

The next belt going northerly is situated about twenty miles north of the Albany river and is well exposed along the banks of the Kawinogans river, which has cut its channel in these rocks for about seventeen miles. This band is from one to four miles in width, and is made up of feldspathic and chloritic schists, diorites and other basic rocks. It is flanked by biotite gneisses, with, at points close to the contact, occasional outcrops of hornblende granite-gneiss.

Another belt, quite similar to the two above referred to, lies just north of Lansdowne lake. Further reference is made to it in the descriptions of the routes leading north from the Attawapiskat to the Winisk. The most interesting belts are the next two; the first, lying just south of Nibinamik lake, by reason of the occurrence in it of a large mass of hypersthene gabbro, similar to the nickel-bearing intrusives of Sudbury; and the next, the Wunnummin lake band, on account of the extensive development in it of heavy beds of coarse conglomerate, holding pebbles, chiefly of various forms of granite. The most northerly band is apparently quite narrow, and was noted only where a few isolated outcrops are seen near Kingfisher lake, north of the Winisk river.



10 ft.	Flaggy and shaly, buff magnesian limestone.
12 ft.	Shaly, impure, rusty-weathering, magnesian limestone.
6 ft.	Flaggy, clinking dolomite.
6″	Compact, slightly magnesian limestone.
6 ft.	Vesicular limestone.
10 ft.	Slightly magnesian, shaly limestone with sandy layers.
2′-6″	Slightly magnesian, nodular limestone.
8 ft.	Slightly magnesian, clinking, flaggy limestone.
10 ft.	Rusty-weathering, siliceous limestone.
6 ft.	Dark grey, rusty-weathering, calcareous quartzite.
20 ft.	Black and green, ribboned slates.

Generalized Section along the Winisk River

Silurian

The Silurian section along the Winisk river seems to comprise, in ascending order, twenty feet of close-grained, hard, brittle, green and black ribboned slates, with bands and nodules of more highly calcareous material; six feet of a hard, dark-grey, rusty weathering, calcareous quartzite; ten feet of a much more calcareous form of the last-named beds, so calcareous as to constitute an impure limestone rather than a quartzite. All of these lower beds, which are exposed at but one place on the river, where they

are brought up by a compound anticlinal fold, are hard and baked-looking, with many small veins of quartz and calcite cutting them in all directions. Lithologically they are quite dissimilar to any of the strata composing the rest of the section. Further effects of pressure are seen in the hardened condition of all the rocks, and in their cracked and fissured condition, the cracks filled with secondary quartz and calcite. The more massive beds described as calcareous quartzites are seamed in all directions by these white, reticulating veins, which are brought into strong prominence by their contrast in colour with the dark, rusty-weathering surfaces of the parent rock.

There seems to be a gradual passage upwards from these beds, by the increase in their calcareous content, into impure limestones, and then into the next beds in the series, consisting of a series of slightly magnesian limestones, comprising eight feet of buff-coloured, slightly ferruginous, hard, close-grained, flaggy beds, with the texture of lithographic stone in certain layers; two and a half feet of more massive nodular limestone, the nodules of finer texture than the enclosing, slightly shaly matrix; and ten feet of rubbly, shaly limestone, with occasional sandy layers. Nodules of bluish opalescent quartz, with banded, agate-like structure, occur in the more compact beds throughout the series.

Above these beds is a very persistent band, six feet in thickness, of a tufaceous-looking, vesicular limestone, the very distinctive character of which makes it easily recognizable at many points along the river. Cavities in it are coated with crystals of calcite, and vesicles and cracks occurring in it are filled with a fibrous form of that mineral. The calcite occurs throughout the rock in irregular masses that weather out to form cavities of irregular sizes and shapes. Immediately above this bed there occurs a 6" layer of a compact yellowish limestone, with but little magnesia; then six feet of very fine-grained, almost compact, very light buff-coloured dolomite, containing a small quantity of argillaceous matter and occurring in heavy flag-like beds, the plates hard and clinking under the hammer. These are overlaid by twelve feet of buff-coloured impure magnesian limestone, shaly in certain layers; and ten feet of flaggy and shaly buff-coloured, somewhat nodular, magnesian limestone, the whole becoming disintegrated easily so as to show only nodular, crubling surfaces.

Broadly speaking, the strata may be said to lie almost horizontally, with a slight dip towards the shores of the bay, amounting to about the same as the descent accomplished by the river. Low undulations cause the same beds to recur again and again in the sections exposed along the river. The exposures are not continuous, long intervals where the overlying boulder clay only is seen intervening between the exposed sections, so that the generalized section given above, and tabulated on the preceding page, is made up from an examination of separated exposures occurring along the river for a distance of eighty miles. Though the strata are uniformly buff-coloured and closely similar in general appearance, a few very distinctive beds—notably the tufa-like limestone bed, which seems to be very persistent and to keep its distinctive characteristics—serve to connect the various exposures satisfactorily. The lowest beds, comprising the thirty-five feet of strata brought up by the compound anticlinal fold, appear at only one place on the river. As no fossils were found in them their age can be inferred only from their apparently conformable position immediately underneath the fossiliferous Silurian strata.

The corrugated surface of the dome of the anticlinal itself dips about ten degrees north of west, at a low angle, varying from five to twenty degrees, and it is possible, though not probable, that the rocks noted by Mr. Dowling at Sutton Mill lake represent underlying beds brought up by a southeasterly extension of this fold.

The calcareous nodules, which probably represent bands broken by the stress of the folding, weather out readily, where exposed to atmospheric action, leaving a rock full of holes.

A small collection of fossils was made from the beds overlying the vesicular band, in which Dr. Whiteaves has identified the following forms:—

Favosites gothlandica, Lamarck.
Strophcodonta niagaraensis, W. and M.
Leptæna rhomboidalis, Wilckens (sp.).
[31]*Camarotœchia* (?) *winiskensis*, Whiteaves.
[31]*Camarotœchia* (?) *coalescens*, Whiteaves.
[31]*Glassia variabilis*, Whiteaves.
[31]*Actinoceras keewatinense*, Whiteaves.
Trimerella, sp. indet.
Orthis, "
Spirifer, "

[31] The two new species of Camarotœchia, the Glassia and the Actinoceras have been described by Dr. Whiteaves in Palæozoic Fossils, Vol. III., Part IV., 1906, where further notes concerning the collection will be found.

Streptelasma, sp. indet.
Trochonema, "
Euomphalus, "
Loxonema, "
Cyrtoceras, "
Bronteus, "
Encrinurus, "

Though not a very satisfactory collection in itself for purposes of age-determination, the above-named species correlate the beds holding them with those of the Severn river to the north, and the Ekwan river to the south, and collections from the three localities combined fix the age of the rocks very satisfactorily.

The southern limit of the Silurian limestones cannot be fixed with any degree of exactness, owing to the heavy overmantle of till that conceals from view the underlying rock for a distance of 130 miles along the river. It seems probable, however, that it extends to the vicinity of N. lat. 54° 20′. Mr. Low found on the Fawn branch of the Severn, the nearest river to the west, the same wide area of country completely covered by till intervening between the most northerly exposure of gneiss and the first exposure of limestone. He thought it probable that the limestones extend under the till for a distance that would correspond very closely to that given above for the Winisk. East of the Winisk river the inland boundary of the Silurian bends suddenly to a direction nearly due south, crossing the Attawapiskat river a little above N. lat. 52° 30′, and the Albany one degree lower.

Pleistocene

The boulder clays of the Winisk river may be easily divided into an upper and a lower till, the one lying upon the gently undulating surface of the other.

The upper bed is composed of a buff-coloured clay, drying slightly friable, with occasional large boulders, and many small pebbles and angular fragments of diorite, quartzite, gneiss, red and white sandstone, jasper, etc. Its greatest observed thickness is about forty feet, measured from the surface of the lower till to the bottom of the fossiliferous marine beds. No stratification is apparent in it, and the large boulders are so rare that, at a little distance, cut faces have the appearance of beds of pure clay.

The lower till, the thickness of which was not ascertained, is composed of an extremely tough blue clay, with very many large boulders, semi-rounded and mostly well striated. Limestones and dolomites quite similar to the Silurian beds of the lower river make up a large proportion of the boulders, but others of gneiss, quartzite, conglomerate, etc., are not uncommon. The sloping beaches extending between low and high water marks are often a mosaic of the washed out material from the clay, forming very good examples of boulder pavements, the natural tendency of the rocks to arrange themselves with their flatter sides parallel to the surface resulting in an almost smooth floor, over which the spring floods seem to pass with little or no denuding power. The whole bed of the river is, in the same way, protected by a layer of heavy boulders that offers great resistance to the wear of the current, and that has practically stopped the further excavation of the channel at levels far from the bottom of the lower till.

The accumulations of glacial drift are an important feature over this whole district. They form the highest elevations, and are the principal causes that define the shapes of the lakes and the directions of the rivers. The influence of morainic ridges of boulders and gravel on the course of a river is strikingly seen in the case of the upper part of the Winisk river. The direction of the ice movement was about S. 23° W., and the course of the river is found to conform to this direction to a remarkable extent, that is, it makes its way eastward in a series of zig-zags, the lake-like expansions conforming in a remarkable way to the course of the morainic ridges of drift.

The lakes occurring along the river are characterized by many long narrow bays with the same trend, due to the drift ridges that bound them.

The glaciation of the whole area shows most clearly that it is the result of the passage of a large glacier, continental almost in extent, moving in a general way a little south of west, but showing minor deflexions, that occurred probably at stages in the period of glaciation when the ice sheet was not at its greatest thickness and was more readily influenced by the surface contours.

The general S.S.W. direction of movement is indicated not only by striæ, chatter marks, and crag and tail sculpturing, but also by the character of the boulders enclosed in the till and scattered broadcast over the Archæan area. The occurrence of the fossil-bearing limestones along the west coast of Hudson bay and James bay, and the entire absence of any rocks at all similar to them over the whole region farther south, makes the character of the travelled boulders derived from these rocks a sure index to the direction followed by the moving ice-sheet. Additional evidence is afforded by the

occurrence in the till of boulders and pebbles of jasper, hematite, quartzite of a very distinctive character that Dr. Bell has recognized in place on the east coast of Hudson bay, and jasper breccia or conglomerate. The wide tract of country lying between the Archæan gneiss and the first exposures of limestone, where the underlying rocks are completely concealed by the thick mantle of boulder clay, might be the source from which is derived many or all of these apparently foreign boulders, but their very close similarity to rocks that are known to occur on the east shore of Hudson bay makes it more probable that they have been derived from them.

A few south-westerly striæ that appeared to be possibly later than the prevailing ones might be interpreted to indicate a glacier travelling down a gathering ground such as has been assigned to the Keewatin glacier. The local variations of the striæ from the general direction are so many, however, that it seems quite possible that they are only the records of deflexions caused by local surface relief, and made perhaps by a very much reduced glacier. No evidence of a glacier moving down towards the bay was noticed. The following list of glacial striæ is arranged under three divisions—the height-of-land region, where the striæ may be considered to represent most truly the general course of the glacier; the Winisk river channel, where the direction of the striæ seems to have been somewhat affected by the river course; and the valleys of the Albany and Upper Attawapiskat rivers, where the direction has been quite governed by the trend of the valleys.

Direction of Glaciation

Height-of-Land Region—	
Kawinogans river	S. 50° W.
Hail lake	S. 40° W.
Wapitotem river	S. 38° W.
Winisk river, eight miles above Weibikwei lake	S. 38° W.
Winisk river, Wapikopa lake	S. 32° W.
Lower Winisk River Region—	
Winisk river below outflow of Winiskisis	S. 6° W.
" at outflow of Tabasokwia	S. 6° W.
" above Tashka rapid	S. 10° W.
" at Tashka rapid	S. 30° W.
" at Boskineig fall	S. 30° E.
" ¼ mile below Boskineig fall	S. 18° W.
" 1 " " "	S. 10° E.
" 2 miles " "	S. 12° E.
" 8 " " "	S. 10° E.
" 13 " " "	S. 24° E.
" 15 " " "	S. 26° E.
Albany River and Attawapiskat River Valleys—	
Eabemet lake, northwest shore	S. 83° W.
" " north shore	S. 78° W.
Albany river, 10 miles below Eabemet	S. 68° W.
" 12 " "	S. 67° W.
" 15 " "	S. 64° W.
Ozhiski lake	W.
Kabania lake	N. 79° W.

Post-Pleistocene

The marine clays, overlying the boulder clays along the Winisk river, were found to be generally fossiliferous, excepting near their most southerly extension where they are quite thin, and, as far as observed, do not hold fossils. From a collection made from these clays in 1903, Dr. J. F. Whiteaves has identified the following species:—

Pecten islandicus, Müller.
Mytilus edulis, L.
Cardium ciliatum, Fabricius.
Serripes Grœnlandicus, Gmelin
Macoma calcarea, Gmelin.
Mya truncata, L.
Mya arenaria, L.
Saxicava rugosa, L.
Buccinum tenue, Gray.
Buccinum ?

and, fresh water species:—

Sphœrium striatinum, Lamarck.
Limnœa palustris, L.

The Winisk River

The Winisk river, though without falls in its lower course, and with a volume that would lead one to suppose it easily navigable by vessels of considerable size, is so rapid and so wide for a long distance up from the bay that it would be difficult to find a channel for a steamer of even moderate draft. This is particularly true of the thirty miles of its course over the flat-lying limestone ledges that often form barriers quite across the river bed, on which there is a depth of only a few feet of water.

The river has cut down into the limestones to a depth of more than forty feet, the strata rising in vertical walls to that height above mean low water level.

There is evidence that the river followed its present channel in the limestones prior to the glacial period. It has since then not worn out for itself any valley beyond its immediate channel, which is a mere trench in the boulder clay in the upper stretches, and in the clay and underlying limestones farther down. The extreme toughness of the lower boulder clay, and the protection afforded by the great number of large boulders that wash out from it and coat the bottom and lower parts of the sides of the trench, have prevented any quick degradation of the banks, which stand up, raw and steep, like the sides of a newly excavated canal or railway cutting. The more gently sloping parts of the bank, between high water mark and the foot of the boulder clay wall, are covered with a growth of grasses and small bushes, and, beyond latitude 54° 30′, the nearly vertical boulder clay itself supports a growth of silver berry, *Elœagnus argentea*, and buffle berry, *Shepardia*, the almost snow-white foliage of the former standing out in strong contrast with the dark-green leaves and red berries of the latter.

The Winisk river, along its upper course easterly to Weibikwei lake, has a distinguishable valley. The lower part of the river, however, from the lake to the sea, has absolutely no valley outside of the steep-walled trough in which it runs. The upper Attawapiskat river, flowing in an easterly direction, has a fairly well-marked valley, comparable to that of the Albany, though of less extent. The upper parts of the river are roughly parallel to one another and to the Albany river, with which it is not at all improbable that the Attawapiskat was at one time connected, as the country now dividing them is characterized by high hills of glacial drift, filling up and concealing any former channels that may have existed. These are the very remarkable hills described elsewhere in this report in greater detail

Parallel Channels a Feature

In all the rivers on this slope is seen the tendency to split up into two or more channels, enclosing areas of land often many miles in extent. This feature is more marked in the case of the Winisk than in any of the others. Above Weibikwei lake one of these divisions of the channel occurs, enclosing an area of thirteen square miles; and below, the two branches known as the Winiskisis and the Tabasokwia flow around islands with areas of about 480 and 180 square miles, respectively. The former of these branches, flowing to the east at a point seven miles below the lake, joins the main river again sixty-five miles below. The Indians say that no important stream comes in to the branch, but a number of small streams makes it a river of considerable size at its confluence with the main channel, even at low water when no water is passing over the bar at its upper end.

The volume of water in the river during the period of spring freshet must be quite ten times as great as at low water in mid-summer. The height reached by the water is, in many places, plainly indicated on the banks.

Evidences of the destructive force of the ice, when running out in the spring, are common. Trees on some of the islands are found broken and uprooted at heights of fifteen feet above the normal water level, and the boulder clay of the banks is ploughed and deeply scored at corresponding heights.

The flat surface of the limestone bordering the gorge is evidently swept annually by the river when at its height, though the water surface in the gorge at ordinary summer level is thirty feet below the top of the limestone.

No beds of lignite were observed, though a few highly carbonaceous, sandy layers were seen to occur at water level, apparently beneath the boulder clay on the upper Winisk river.

Owing to the frequent small landslides occurring along this part of the river it was impossible to fix the position of these beds with any degree of certainty.

Though for so great a part of its course the river is bordered by high and steep banks of clay, landslides seem to be exceedingly rare, excepting where the country has been swept by forest fires. Where fires have recently taken place along the banks, denuding them of their protecting vegetation, small landslides are almost continuous.

Wunnummin Lake and Asheweig River.

The Winisk is with little doubt the largest of the rivers discharging into the west side of Hudson bay or James bay between the Severn and Albany rivers. Rising in the highlands lying to the south of Trout lake, it drains the large expanse of country lying to the east of the upper waters of the Severn river, and to the north of the spreading branches of the Attawapiskat. The watercourses of this section of country have been most inadequately represented on the existing maps, owing to the lack of knowledge of their positions, and a reference to the map accompanying this report will be necessary in order to understand the apportionment of the watersheds among the various rivers. From Misamikwash lake, above which the Winisk is divided into two main and many smaller branches, the river flows out by two channels, one quite insignificant in volume flowing to the north, and the other, a river of considerable size, flowing to the east. The former of these forms the head of the Asheweig or west branch of the Winisk, and the latter the main river.

Diverging at a point situated in N. lat. 53° and W. long. 90°, these two streams unite 224 miles below, following the course of the main river in N. lat. 54° and W. long. 87° 30′.

From Misamikwash lake and for twenty-five miles the river keeps a general easterly course. In this distance the descent is about thirty-five feet, and occurs principally in a series of five rapids, at the lowest of which, just above Wunnummin lake, there is a very considerable fall. Between the rapids are stretches of swift water, varied by many lake-like expansions. The surrounding country is for the most part low, seldom rising to greater heights than fifty feet above the river. Few rock exposures are seen, what there are consisting of low, rounded knolls and ridges of well foliated biotite granite gneiss, generally with an almost horizontal foliation and often invaded by a coarser white granite or pegmatite. The banks are usually low, but in places the river is found impinging against a bank of unstratified sand and gravel twenty to thirty feet in height.

Wunnummin Lake

Below the rapid and fall just referred to a large stream comes in from the south, and the river widens out to form Wunnummin lake, a body of water of varying width, twenty-five miles in length. The trough in which the lake lies has been hollowed out mainly in a band of Keewatin rocks to whose trend it generally conforms. The most conspicuous rocks occurring in the belt are heavy beds of coarse conglomerate, very similar to that of Abram lake on the English river below Minnitakie lake.[32] With these are associated diorites and chloritic and hornblende schists, the whole striking about N. 70° E. and dipping at high angles. These rocks can, without doubt, be classed almost wholly with the Keewatin, though there are possibly small areas of lower Huronian, the basal beds of which would be represented by the conglomerate.

About the lake almost the only eminences in view are low hills of unassorted drift, rising generally not more than fifty feet above the water level, but in one case forming a very striking cone-shaped eminence, rising perhaps 300 feet above the surrounding level. Owing to its inaccessibility this hill was not visited, but from its general aspect, and from the accounts of it given by the Indians, it evidently is one of those remarkable, isolated masses of drift seen on the south branch of the Attawapiskat, and noted also by Mr. Camsell as occurring in the country north of Cat lake.[33]

From Wunnummin lake to Nibinamik lake, a distance of twenty-five miles, the descent is about forty-five feet, the fall occurring principally at three points, where series of heavy rapids break the course of the river. Between these are stretches of quiet flowing water, where the current, though generally strong, flows along placidly between banks of sand not generally high, but in places, where the current has worn into the side of a drift ridge, showing cut banks seventy-five feet in height. A stream known as Michikenis flows in from the south about six miles below Wunnummin lake, and a larger one, referred to again in describing the route from Trout lake, joins the river from the north five miles above Nibinamik lake.

Nibinamik and Wapikopa Lakes

Nibinamik lake is an irregular body of water whose shape has been largely defined by ridges of glacial drift. From inlet to outlet is but five miles, the lake, however, extending to the south for seven miles and to the north for four miles. A number of low ledges of fine, well-foliated biotite gneiss occur along its shores, cut by a coarse white gneiss that often is interbanded with the finer, giving the whole an appearance of stratification. The land rises gradually from the lake shores to heights of about sixty feet, a considerable thickness of sand and gravel concealing the underlying rocks, excepting at

[32] Annual Report Geological Survey, 1901, Vol. XIV., p. 90 A.
[33] Summary Report Geological Survey, 1901.

the immediate shores. A forest about one hundred years old, but never very large, covers the surrounding country. Spruce and tamarack are the principal trees, with aspen, poplar, and canoe birch on the ridges.

From the southern end of the lake, by a large brook entering the southeasterly bay, a route to be referred to again, leads to the Attawapiskat river.

For the next twelve miles, between Nibinamik and Wapikopa lakes, the river flows with a fairly stiff current, increasing to rapids at three places, and descends in all about thirty-five feet. No ledges are seen along the shores, the over-mantle of drift, rising in places to form ridges ninety feet in height, quite covering the underlying rocks.

Wapikopa lake has a length northeasterly of thirteen miles, with a long irregular bay running to the north for fourteen miles, where it receives the waters of the river of the same name, a quiet flowing stream thirty yards wide, two to six feet deep, and with a sluggish current of about one mile an hour.

Many exposures of biotite gneiss occur about the lake-shores, the foliation being well marked, and dipping at angles of from forty degrees to horizontal. A coarser grey gneiss cuts these stratiform beds, and encloses in places angular blocks of the finer black gneiss in such numbers as to constitute a breccia.

A newer reddish granite, with porphyritic crystals of red feldspar, occurs in heavy ledges near the west end.

Green forest, from thirty to one hundred years old, clothes the shores of the lake on every side.

Weibikwei Lake

From Wapikopa lake downwards to Weibikwei lake, a distance of thirty-eight miles, the river follows a most irregular course, and really constitutes a succession of lakes, with intervening rapids, the total descent being about eighty feet.

The lake-like expansions are remarkable for the way in which the long, narrow bays running off from them, conform to the direction of glaciation. This is caused by the recurrence of parallel ridges of glacial drift, with a direction about N. 30° E., the valleys between them forming the basins of the lakes.

A number of small rapids occur where the river breaks through the drift ridges, and for ten miles immediately above the outflow of the channel coming in below Weibikwei lake the current is very swift, and heavy rapids occur, some of them over ledges of biotite gneiss.

These rocks, the only exposures seen, are fine, banded black and grey biotite gneisses, dipping at various angles, but preserving a general north-easterly trend. They are invaded by irregular masses of a coarser white gneiss, that sometimes occurs as bands conforming to their foliation, but often cuts them in the form of apophyses, and surrounds and encloses angular blocks and masses.

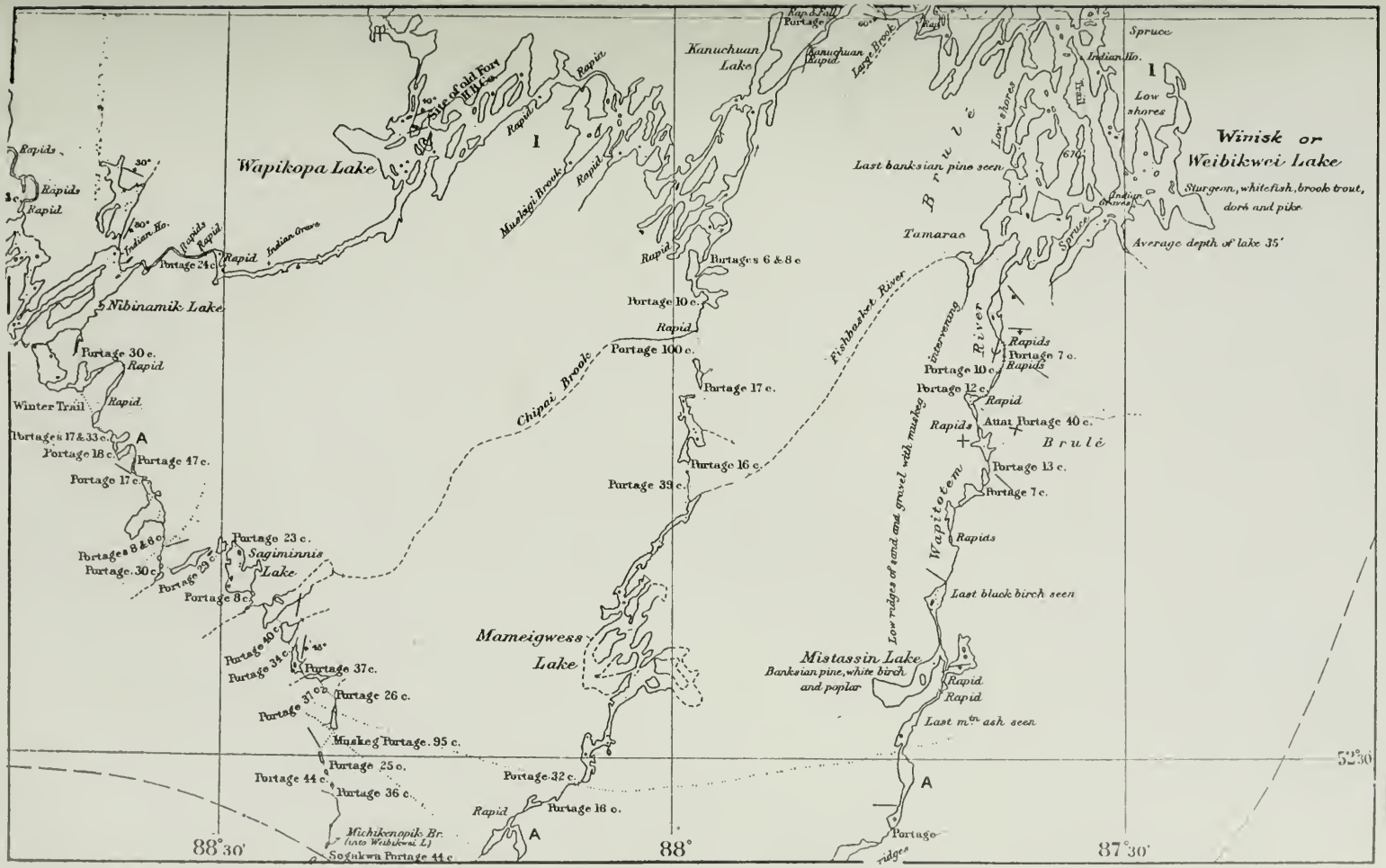
Midway, at a point above Kanuchuan lake, where the river divides into a number of channels, a small brook flowing in from the south is the starting point for a route across to Lansdowne lake, and nine miles above Weibikwei lake a channel leads off to the north, rejoining the main river just below that lake.

The southern channel of the river flows into the north-westerly bay of Weibikwei lake and discharges from its extreme northern end.

Weibikwei lake has an extreme length of seventeen miles, and is seven miles wide. Two rivers of considerable volume flow into its southern end, the Michikenopik (stone fish-trap)—known on the old maps as the Fishbasket river— and the Wapitotem, up which the principal canoe route to the south leads.

The lake, though of considerable area, nowhere shows any wide expanse of open water, consisting of a series of long, narrow channels, lying about north and south, between parallel low islands of sand, gravel and boulders, with a substratum of till reaching about the level of the top of the water. The passages are not generally more than half a mile in width and only thirty feet in depth. The land about the lake is low, and has been almost entirely denuded of trees by recurring fires, excepting in a few localities where Banksian pine, tamarack, and spruce of fair size remain to show the character of the original forest. Sturgeon, whitefish, pike and doré of good size are plentiful in the lake, and the Indians say that brook trout are not uncommon, but that lake trout do not occur. The only ledges about the shores are biotite gneisses that form low points near the southern end of the lake.

The river discharges from the extreme northern bay of the lake by a short rapid, with a fall of three or four feet. Just below the rapid, at the head of a long bay that extends for several miles to the west, the channel which leaves the river ten miles above rejoins. This is probably really the main channel of the river. Below the junction the river flows for the first eight miles of its course over horizontally foliated ledges of banded, biotite gneiss, that cause an almost continuous succession of rapids with swift water between, down to the point of outflow of the Winiskisis, a channel that flows off to the north-east, to become reunited to the main river seventy miles below. At



Winisk or Weibikwei, Nibinamik and Wapikopa Lakes.

low water, no water flows over the bar at the entrance to this channel, though there is, at all stages of the water, a river of considerable size coming in at the junction, due, the Indians say, not to any single large stream, but to a great number of smaller tributaries draining the country between this stream and the heads of the Ekwan and Black fence branch of the Attawapiskat rivers. Thirteen miles below the head of the island thus formed, another branch channel, called the Tabasokwia, splits off to the west and flows around an island about twenty-three miles long. For forty-five miles below the lake, or to the upper edge of the till-covered area, the river is an almost continuous rapid, the descent being probably as much as seven feet to the mile. At two points only do these rapids become cascades, both situated near the bottom of the very rapid section.

Boskineig or Smoky Fall

At the Tashka rapid the vertical fall is not great, but at the Boskineig or Smoky fall there is a vertical pitch of about fifteen feet. The portage past the first of these rapids mounts over a low ridge of boulder clay, but cut banks, showing a section through the till, are first seen just above the Boskineig fall, where the river has cut down through twenty feet of an upper buff-coloured clay, and six feet of an underlying, exceedingly tough blue clay holding many well striated boulders.

Below the fall the cut banks of boulder clay become higher, and a few inches at the summit are seen to be stratified. Four miles below in the thin layer of stratified beds at the top, the first fossil shells, *Saxicava rugosa*, were noted, proving these beds to be of post-glacial, marine origin. The height above the sea is estimated to be about 350 feet. The banks along this part of the river's course are low, rising gradually from almost water level to heights of not more than fifty feet above it.

Frequent exposures of biotite gneiss generally nearly horizontal, but much disturbed by intrusions of a coarser white gneiss, and by veins and apophyses of pegmatite, occur all along the river. They are low, rounded, well-glaciated ledges, showing well-marked striation in a general direction varying from south to south-west, but showing occasional striæ, that are probably later, having a direction about south-east. Down to this point, and for a few miles beyond, the old forest has been destroyed by the same fire that swept the shores of Weibikwei lake, and its place taken by a second growth about thirty years old.

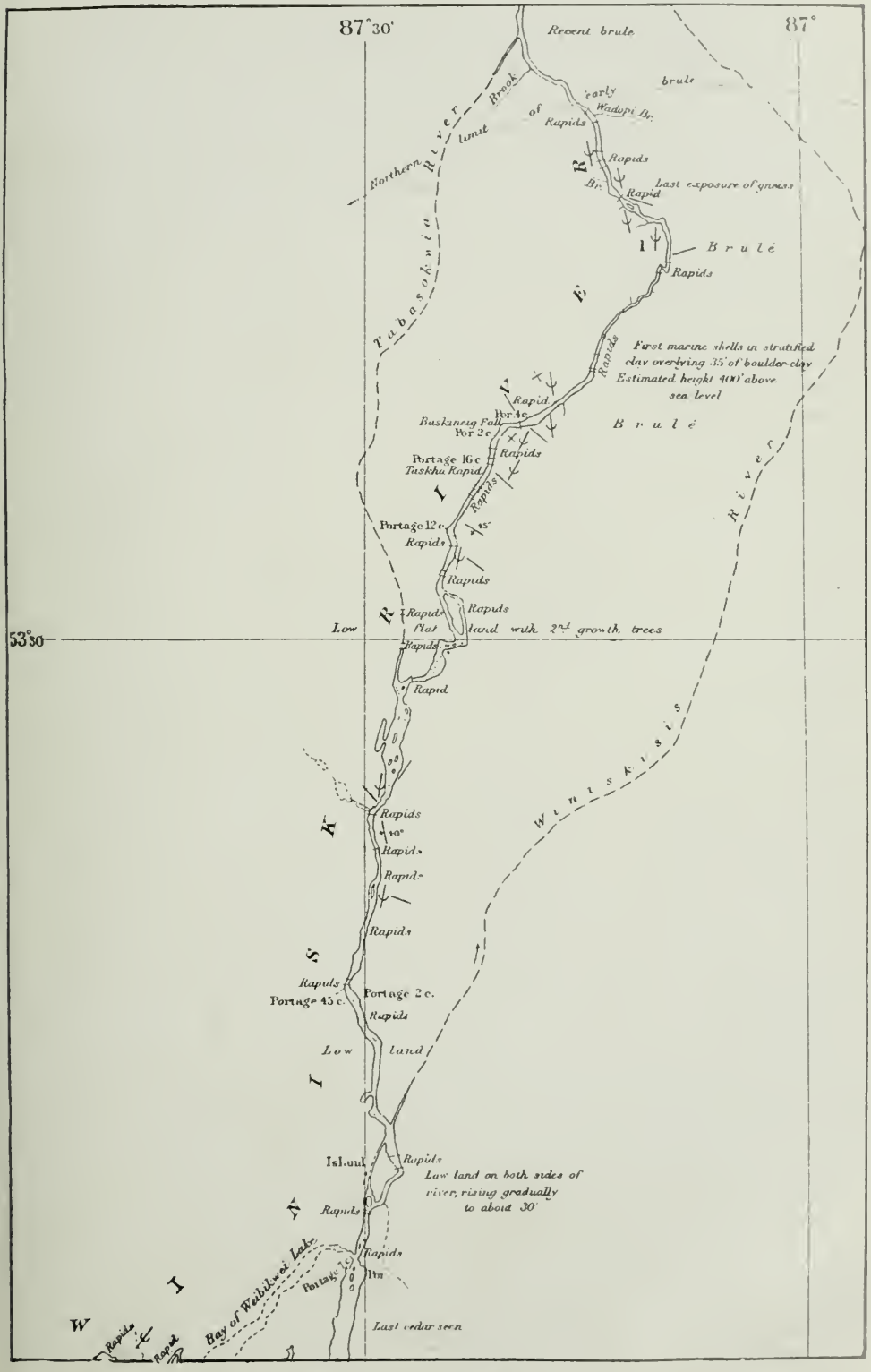
Occasional low bosses of biotite granite-gneiss are exposed along the shores for sixteen miles below Boskineig fall. A horizontal or gently undulating foliation is well developed, though the regular uniformity of their attitude is marred by frequent invading masses of coarse white gneiss and pegmatite. These exposures are the last that outcrop along the river until the outer rim of the limestones of the Hudson bay basin is reached, 140 miles below. Though the bottom of the trough gradually becomes lower in reference to the surface of the till as the river is descended, at no place in this distance has degradation been carried far enough to expose the underlying rocks, the great number of boulders derived from the wearing away of the till probably becoming an increasingly important factor in retarding the wearing action of the current.

Below the last exposure of gneiss the old forest still clothes the banks, the brulé above referred to extending only to that distance. The banks of the river preserve, all along the part of its course lying within the till-covered area, a very uniform character. The shores between low and high water mark gradually slope up from the waters' edge, and are often paved with boulders, and marked at the upper edge by a belt of low bushes and grasses. From high-water mark the bank of boulder clay rises in an almost sheer wall, bare and raw looking, like the side of a recent railway cutting or canal; the lower till often rough with the great number of projecting boulders, but the upper smooth-faced like a pure clay. Capping the upper clay is a very unequally distributed layer of marine clay, in places reaching a thickness of ten feet, but over long distances entirely wanting.

An Area of Imperfect Drainage

The impervious character of the till, together with its nearly flat or gently undulating surface, gives to the country a muskeg-like character, even though it lies eighty feet or more above the bed of the river. Along the immediate banks, and for perhaps a chain or two back, there is a narrow belt of trees of fair size, and back of that stretches away a great level, plateau-like country, practically without drainage, and consequently moss-covered to a great depth, supporting a stunted and deformed growth of black spruce and tamarack. There is no river valley, the trench cut in the boulder clay being but little wider than the actual bed of the stream. The comparatively stable character of the till walls is indicated by this belt of larger growth, as, were the disintegration proceeding at all rapidly, the ordinary condition of tree growth would prevail quite to the edge of the trough.

At sixty-eight and seventy-seven miles, respectively, below Weibikwei lake, the Tabasokwia and Winiskisis channels rejoin the parent stream, the latter now of con-



Part of Winisk River, below Weibikwei Lake.

siderable volume. At a lake-like expansion studded with islands, situated seven miles below the inflow of the Little Winisk, the first tributaries of importance join the river, the Asheweig flowing from the south-west, and the Atikameg from the south-east. The former of these, which is slightly the larger, is the West Winisk of the old maps, and the stream referred to on a former page as flowing out from the main river at Misamikwash lake, 224 miles above. At its outlet it is a quiet flowing stream, with a good current a chain or more in width, and having an average depth of about four feet. A short distance below this point white birches and balsam spruces are seen for the last time on the banks, and thence to the sea the forest growth, quite to the edge of the river trough, is composed entirely of black spruce and tamarack. The islands, and here and there a projecting point, however, continue to show groves of white spruce, balsam poplar and aspen.

After a course almost directly north, with slight curves to the east and west for 126 miles, the river by a sharp turn suddenly changes its direction to a little south of east, and keeps that trend for seventy miles.

Looking down the valley from a point a few miles above the elbow, the land to the north, beyond the turn, is seen to be elevated a little above the general level, the line of higher ground probably representing the northern edge of the Silurian basin. The abrupt turn made by the river, and its long detour to the east before resuming its normal northerly direction, may probably also be attributable to the presence of the barrier offered by the rim of the limestone areal.

The Banipatau and Pikwakwud

Two tributaries, the Banipatau and the Pikwakwud, join the main river near the elbow. Both head near the Fawn branch of the Severn river, and by the last-named there is a canoe route to the Severn. The Winino brook comes in from the north about halfway down the easterly stretch, and nine miles farther on an island six miles in length, known to the Indians as Atikminis, or Caribou island, divides the river into two channels of nearly equal volume. The almost sheer walls of boulder clay, with their intermittent and irregular capping of marine clay, continue to rise in reference to the river bed, until at a point fifty miles above the mouth they attain a height of eighty-five feet above the water level, with a bed of but slightly bleached and not at all decayed sphagnum moss on top. The marine clays, with their contained fossils—a list of which is published elsewhere in this report—immediately underlie the moss. The limestones and dolomites of the Hudson Bay basin first outcrop at a distance of forty-two miles from the bay, measuring along the river. They are flat-lying, slightly magnesian, flaggy limestones, forming the bed of the river, but not appearing above the water. Within a very few miles, however, the slope of the river carries it below the surface of the limestones so that they form low walls, gradually increasing in height in reference to the surface of the water until, four miles below, the river flows through a gorge cut to a depth of thirty feet in the limestones and dolomites. This is probably a part of an old pre-glacial channel, as from here on down towards the sea the limestone walls, capped by boulder clay, alternate with banks that show till only down to high-water mark. The surface of the country, extending back from the sides of the river-trough, has the same plateau-like character stretching away as far as the eye can see, as an almost level, moss-covered plain, with only a sparse growth of stunted trees.

The limestones show gentle undulations, but are, broadly speaking, nearly flat, with a slope northerly corresponding closely with the descent of the river. A small collection of fossils, determined by Dr. Whiteaves, is referred to more at length on another page. They serve to satisfactorily fix the position of these beds as Silurian, and of about the age of the Niagara.

At a projecting point on the south-east bank, twenty-six miles from the mouth, an entirely different set of rocks is brought to the surface in the form of a double anticlinal fold, whose axis strikes south 70° east. These consist of banded green and black slates and calcareous quartzites, the whole very hard and baked looking. No actual contact with the overlying dolomites or limestones is seen, so that it is not possible to say with certainty whether or not the two sets are conformable. It seems very probable, however, that the upper beds, that gradually merge upwards from a calcareous quartzite into a highly siliceous limestone, underlie conformably the lowest stratum of limestone. No fossils were found in these beds. The ribboned character of the slates, their bright colouration, and the occurrence in them of streaks of more highly calcareous pebble-like pieces that are very suggestive of broken limestone bands, give to them a most striking appearance, and would make their recognition, if exposed at any other place on the river, almost a certainty. It was considered at the time that these might represent a part of the Nastapoka series noted by Mr. Dowling about thirty miles to the east, on Sutton Mill lake. There does not seem, however, to be a sufficient similarity between these beds and those described by Mr. Dowling to warrant this correlation. Below this point, and down nearly to the mouth of the river, the limestones and dolomites, for the most part a repetition of the same beds lying in low undulations, are almost

continuously exposed, forming low cliffs, overlain by a thick mantle of boulder clay. The river along this part of its course is about thirty chains wide, with many expansions three-quarters of a mile or more in width, and dotted with islands.

The Mattawa and Mishamattawa

The Mattawa, a river of considerable volume, by which there is an Indian canoe route to the Ekwan river, comes in from the east twenty-four miles from the mouth, and ten miles farther down the Mishamattawa, or Big Mattawa, flows in from the west. This stream is used by the Indians as an inland canoe route to the mouth of the Severn, which is reached by ascending the stream almost to its head and crossing thence to the Shagamu, which flows into the west shore of Hudson bay about a day and a half's journey below the Severn.

For the last twenty-five miles of its course before reaching the shores of the bay, the river has an average width of about three-quarters of a mile, but expands to over a mile at many places. An almost continuous line of islands divides it into a number of channels all along this part of its course. For the last twelve miles above the sea these islands are generally low, and clothed only with grasses and low bushes, but varied by occasional more elevated ones that support groves of balsam poplar of good size. Above this the islands are mostly masses of till that have resisted the wear of the current; they are higher and generally well-wooded with large white spruce, that attain diameters as great as two feet, and are tall and straight.

The current is swift for the whole distance from Webikwei lake to the mouth, a distance of 240 miles, though across the boulder clay area, and through the limestones, the descent is comparatively uniform. Though there is water enough all along for tracking canoes, a channel suitable for larger boats could only be found by following a very tortuous course, and by frequently crossing from side to side, where the flat limestone ledges, approaching the surface, form almost continuous barriers across the current, with perhaps only one break where the water has any considerable depth.

Characteristics of River Bed

This even slope is characteristic of all the rivers flowing from the great central Archæan plateau downward to the west coasts of Hudson and James bays, after they have passed the more elevated Archæan country and reached the gently sloping till-covered area. The Albany, the Attawapiskat, and the Severn rivers are other examples of this. The absence of any valley might be interpreted to mean that the river, in its present form, is very recent. It must be borne in mind, however, that evidence of a considerable age is afforded by the gorge in the limestones where the river flows in a channel cut down at least forty feet into the flat-lying strata, and all along in its passage through the sedimentary belt its pre-glacial age is indicated by the cliffs of limestone that appear alternately on the one side and on the other, with boulder clay forming the banks in the intervening spaces, constituting what is practically a broad, shallow, partly till-filled gorge all the way.

It seems evident, then, that through the boulder clay area, until the limestones are reached, the present channel does not necessarily represent an older valley, but that below, through the limestones, the river has resumed possession of an older, pre-glacial channel.

Approaching the mouth the banks become lower, and for the last few miles are not generally more than about fifteen feet high, and are composed of stratified clays and sands. Bordering each side of the river at the estuary, and extending back from the shore of the bay to form a belt from two to five miles in width, a treeless tract four or five feet above ordinary high tides extends away to the east and north, and is probably continuous, almost without interruption, up and down the west shore of the bay. It is a comparatively level plain, intersected, however, by many channels that are filled at high tide with a gravelly and sandy surface sparsely covered by clumps of grass and brightened by many species of sub-Arctic flowering plants. The river has an easterly direction just at its mouth, and the south shore consequently becomes, without change of direction, the coast of the bay; and it is only by the turning away to the north of the opposite shore that the actual mouth of the river can be fixed. At this point the estuary has a width of about three miles. It is generally shallow, large boulders showing above the surface even at high tide, while at low tide bars of sand, gravel and boulders are exposed. The ordinary rise and fall of the tide is only about six feet, but this is sufficient, so flat is the bottom of the bay in this neighbourhood, to expose at low tide wide sand flats extending far out from the actual shore line and dotted with large blocks and boulders, mainly of limestone, that in places are heaped together to form points and low ridges that remain uncovered even at high tide.

The shallow character of the bay was further evidenced, when the mouth was visited in August, 1903, by the barrier of pack ice that formed a continuous line across the estuary, about five miles off shore. The small sailing vessel used by the Hudson's Bay

Company for the transport of supplies from the post at the mouth of the Severn river to the Winisk river is forced, by the shallow water off the mouth, to make a long circuit, following the channel of the river from far out in the bay.

The length of the Winisk actually traversed, from Misamikwash lake to the mouth, is 365 miles. As it is a river of considerable volume at the upper point reached, it may be confidently stated that its total length is well over 400 miles.

Its volume was estimated to be about 25,000 cubic feet per second in midsummer at a point twenty-five miles above the bay.

To avoid the difficult navigation of the west coast of Hudson bay, the Indians have well-known routes both east and west from the Winisk, the western leading to the Severn river by a stream called the Mishamattawa, which enters the Winisk six miles from the mouth. From near the head waters of this stream the Shagamu river is reached by a portage route, and that stream is descended to the coast, which is reached at a point about a day and a half's journey from the mouth of the Severn river. The eastern route leaves the Winisk eleven miles from the mouth by its tributary, the Shamattawa. This stream is ascended to a large lake on its course, and one of the tributaries entering the lake is utilized to reach a stream flowing in to the Ekwan river by which the western side of James bay is reached. By this route the hazardous journey for canoes along the exposed west coast and around the point of Cape Henrietta Maria is avoided.

The Attawapiskat River

The Attawapiskat river was examined to the main forks twenty miles above Lansdowne lake, and its southern branch, the Kanuchuan, for 135 miles farther, where it overlaps the foot of Lake St. Joseph at a distance of about fifteen miles to the north.

A micrometer survey was made of the greater part of this distance, connecting at one end with Lake St. Joseph and at the other with Fort Hope post on Eabemet lake.

The Attawapiskat watershed was first reached at Wimbobika and Kapichegima lakes, lying about twelve miles to the north-west of the north-easterly end of Lake St. Joseph. The upward continuation of the river is represented by two large brooks flowing in from the west, and one, known as the Rice-stalk river, from the north. The latter affords a canoe route to Cat lake. This has been traversed by Mr. Jabez Williams, of the Hudson's Bay Company, who reports that biotite gneisses only are exposed along the route.

These lakes, both long, narrow and trending about east, parallel to the prevailing strike of the gneisses in that vicinity, are separated by a low ridge of chloritic, feldspathic hornblende-schists that occur in a belt, at this point not more than three-quarters of a mile wide. The westerly extension of this belt was not traced, but it probably does not reach the shores of Lake St. Joseph, as it appears to be tapering in this direction. Easterly it was traced pretty continuously, as the stream valley has been excavated in these rocks practically all down its course.

The outlets of these two lakes unite a few miles below to form the small river known to the Indians as the Kawinogans, or No-Pikerel river. For twenty-five miles below the junction the river has a width of only from one to two chains, and is swift flowing and broken by numerous rapids. At frequent intervals exposures of chloritic and feldspathic schists outcrop, striking both to the north and south of east, or parallel to the general course of the river valley.

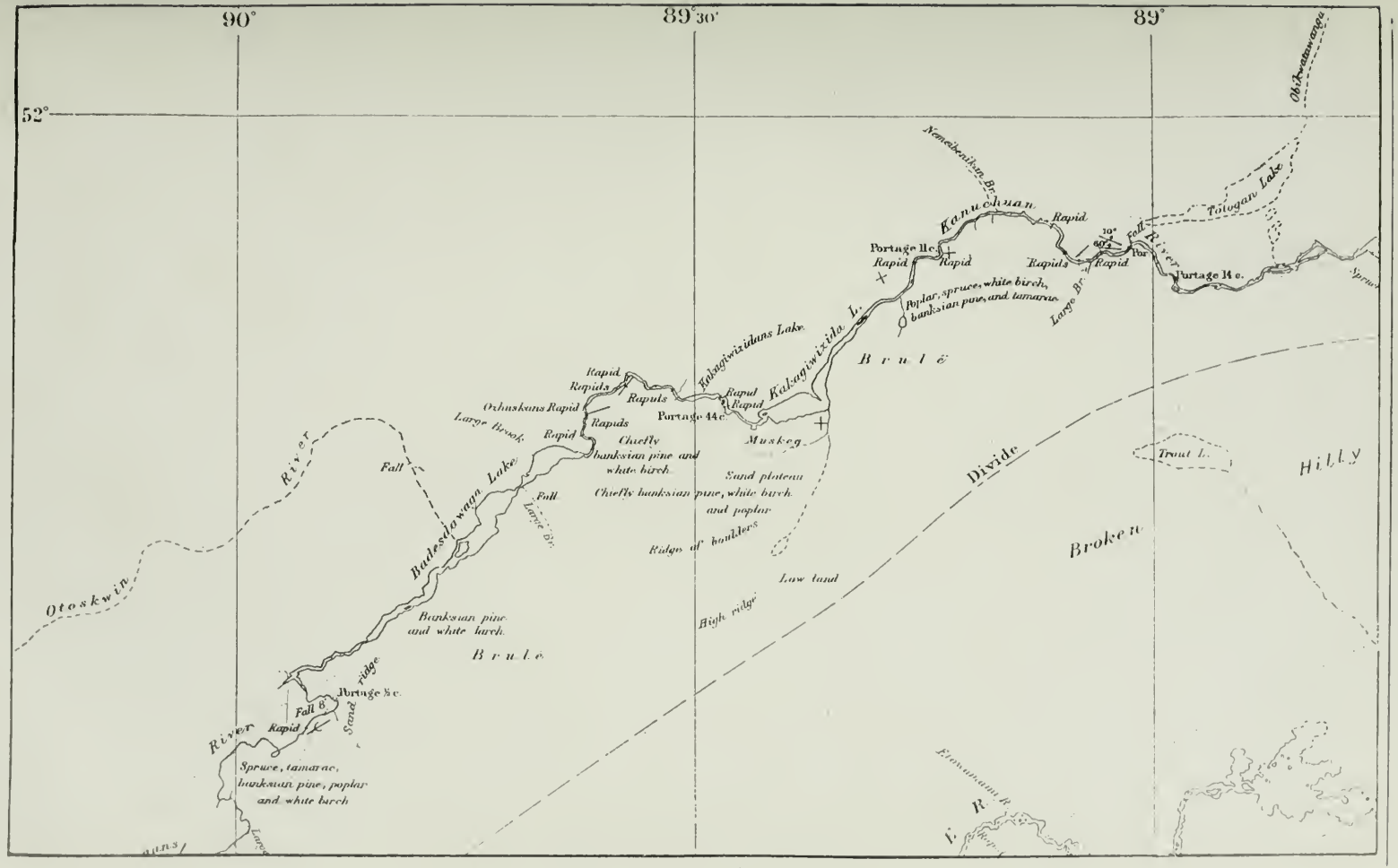
Associated with the schists are more or less schistose diorites, and massive pyritous quartz diorites. At the edge of the belt is a strip of hornblende granite gneiss similar to the biotite gneiss, excepting that in it the biotite has been replaced by hornblende.

The trend of the belt of basic rocks would carry it to the south of the long narrow lake called by the Indians Kagabades-dawaga. Excursions inland from the south shore of this lake revealed no outcrops, and as no further exposures of these rocks were seen on the river, the belt probably terminates in this direction not far east of the head of the lake. Along the lake shores ledges of rock were seen at only one point, where obscurely foliated biotite gneisses are cut by a later granite of medium grain.

Stratified fine white quartz sand, underlain by blue clay and overlain by gravel, forms banks from ten to thirty feet in height all along both sides of the lake.

Among the beach pebbles, which occur in great variety, are included dolomites and fossiliferous limestones, as well as many large semi-angular blocks, indicating that the underlying clay is probably a till.

Where the banks are low, and fresh sections are afforded by the work of the waves, a layer of peat from two to three feet thick overlies the clay. From the south shore of the lake a rolling, sandy-covered slope, the surface coated with white moss, and supporting an open growth of jackpine, white birch and spruce, gradually rises to the summit of a ridge two hundred feet or more above the river. Along the side of the ridge, which is



Kanuchuan River above Ozhiski Lake.

entirely of drift material, are numerous cirque-like depressions sixty to ninety feet deep, with steeply-sloping sides, and in a few cases holding up small ponds of water. The opposite or south-east side of the ridge falls away abruptly, at as steep an angle as the sand will assume, to another rolling sandy plateau that extends for miles to the south-east.

The Otosk or Elbow river, probably the longest of the various branches of the Attawapiskat, as it heads near the north-east end of Cat lake, flows into the lake from the north-west, about half-way down its northern side.

Kakawizida and Ozhiski

Eleven miles below, after flowing in an easterly direction past a number of rapids, with occasional outcrops of biotite granite-gneiss, the river expands to form Kakawizida lake, a shallow body of water ten miles in length and a mile wide. The same rolling, sandy plain, with extensive tracts of muskeg where it approaches the south shore, surrounds the lake. Beyond the muskeg area, which extends for two miles or more back from the lake, the land gradually rises to about a hundred feet, where glacially planed surfaces of gneiss, coarse and obscurely foliated, outcrop through the drift covering. Beyond, the sandy flat gradually gains in elevation southwards for five or six miles, and then rises sharply to form a ridge of gravel and boulders 300 feet above the lake, only a few feet wide at the summit, and falling away abruptly to the south and east to a well-wooded valley. An open forest of banksian pine covers the whole of the sand plateau.

From the summit of the ridge described others are seen, apparently of similar character and with the same general east and west trend. Twenty-nine miles farther down the river, which still keeps an easterly direction, Ozhiski or Mud lake occupies a shallow trough, twenty-one miles long and a little over two miles wide at the broadest part. Shelving ledges of biotite granite gneiss, lying nearly horizontal, or gently undulating, occur at many points along the shores. The country traversed by the river for the last fifty miles above the lake is characterized by very heavy deposits of drift, mostly stratified and often from fifty to sixty feet in thickness. Where sections are exposed along the river or lake shores by the wear of the water, the greatest thickness is seen to be occupied by very fine, white quartz sand and siliceous clay, underlain by a tough blue clay, in fine laminations, and overlain by irregularly distributed deposits of coarse sand and gravel. Underneath the whole, and resting immediately upon the bed-rock, are deposits of till of unequal thickness, that at no place are exposed in section.

Occasional lenticular layers of indurated calcareous material, one to two inches in thickness, holding approximately 59 per cent. of calcium carbonate, occur in the siliceous clays. Two specimens of the clay were examined by Dr. Hoffmann, one from the neighbourhood of Ozhiski lake and one from higher up to Kanuchuan river. Differing only in the proportion of their lime content, they are described as slightly ferruginous, feebly plastic, readily fusible clays, holding a large quantity of siliceous grit and containing from 27 to 30 per cent. of calcium carbonate. In combination with the vegetable mould of the surface these clays should form a soil very suitable for general agriculture, though they are evidently not of value for industrial use as clays.

Flowing out from the north side of Ozhiski lake the river continues northerly for fifteen miles, with many heavy rapids and a high average rate of flow, to an elbow, where it changes the direction of its course sharply to the east.

The Pineimuta Branch

Ledges of well foliated, banded, biotite granite-gneiss protrude through the drift mantle at frequent intervals along the river valley, generally lying at low angles, but in places very much contorted and crumpled. The prevailing strike is about north-east. The Pineimuta, or north branch of the Attawapiskat, comes in from the west just at the elbow. Though somewhat smaller than the south branch, this is a river of considerable volume. For the first few miles above the forks it is broad and smooth-flowing, with banks of clay and sand, and is then broken by a high fall, above which it receives a large tributary that drains Totogan lake, lying a short distance to the north of the south branch, above Ozhiski lake. Above this the Indians say that the river takes a very long bend to the north and then south-west, and heads near the sources of the Pipestone branch of the Winisk. From the elbow the river, now nearly doubled in volume, flows easterly for twenty miles into the long south-westerly bay of Lansdowne lake. It is a succession of lake expansions, with connecting rapids, which, though they are rough, can all be run by loaded canoes. Kabania, eleven miles long and generally quite narrow, is the largest of these lakes. The land about the lake is low and drift-covered, nearly horizontal, but contorted ledges of banded, biotite gneiss, with glaciated surfaces show at intervals.

Lansdowne lake, and the lower Attawapiskat river to James bay, have been described by Dr. Bell in his report, published in 1887.

Routes Between the Attawapiskat and Winisk Rivers

The tract of country lying between the Attawapiskat and Winisk rivers was crossed by three canoe routes, two starting from Lansdowne lake and one from the Attawapiskat river, ten miles above the lake, and striking the Winisk at Weibikwei lake, between Wapikopa lake and Kanuchuan lake, and at Nibinamik lake respectively. The first-named route leaves the extreme north-easterly bay of the lake, and reaches the height-of-land by way of a small, boulder-strewn brook, flowing through low land, with occasional gravel and boulder ridges of moderate height. After crossing the divide the route follows the course of the Wapitotem river, through numerous lakes, down to the south bay of Weibikwei lake. For the whole distance the country is characterized by drift ridges, rising from seventy to one hundred feet above the general level, with areas of muskeg and low, sand-covered flats occupying the intervening valleys. For the first thirteen miles north of Lansdowne lake no exposures of rock *in situ* are seen, the drift cover hiding completely the underlying rock. A low ridge of slightly schistose, hard, chloritic diorite, specked with iron-pyrites and striking east and west, is the first outcrop observed. The width of the band of which it forms a part cannot be determined even approximately, as to the north the first rock outcropping through the drift occurs on Mistassin lake, six miles farther on, and to the south the nearest is on Lansdowne lake, nineteen miles away. These, in both cases, are biotite gneisses, the last being the first of a series of exposures that occur at intervals all the way down the stream to Weibikwei lake. The trend is in a general way about east and west though satisfactory strikes are seldom seen owing to the contorted character of the strata, due principally to pegmatite invasions where the foliation is plain, or to obscure foliation.

The prevailing type of rock is a hard, reddish, banded, biotite gneiss, lying nearly horizontal, stratiform in appearance and cut by irregular masses and veins of coarse white pegmatite. The distance across by this route is sixty-five miles, and for the whole distance the country, excepting a few, low, muskeg areas, has been repeatedly swept by forest fires, so that many of the ridges show surfaces of bare boulders and gravel, and others a second growth of banksian pine, white birch, aspen poplar, spruce and tamarack. In the muskeg tracts only spruce and tamarack grow, and the trunks do not attain a size to be of industrial value.

Low, rounded bosses of biotite gneiss, varying from very coarse to quite fine, and containing a large proportion of biotite, are exposed at intervals to beyond Sagaminnis lake. The prevailing strike is a little west of south. At the north-east end of a long portage between two small lakes, lying about midway in the series, one of these low bosses is composed of interbanded fine quartzose gneiss and hornblende schist, the fine gneiss resembling a finely micaceous, schistose quartzite, and the whole striking in conformity to the foliation of the gneisses that are exposed at no great distance on either side. The strata are much shattered and seamed with quartz veins containing iron sulphide. This is probably an offshoot from, or continuation of, the belt to be next referred to.

Crossing another divide the route continues to Nibinamik lake, through numerous small lakes occurring along the course of a small tributary flowing north-westerly into the most southerly bay of the lake. The stream valley follows the trend of a belt of basic rocks from one to two miles wide, and traced in a compound curve northerly, north-westerly, and north-easterly for twelve miles.

Hypersthene Gabbro

Chloritic and hornblende schists, associated with highly altered and sheared quartz diorites, are the prevailing rocks at the lower end of the belt. Farther north on the band more massive, hard diorites, and coarse diabases altered in places to obscurely schistose chloritic rocks occur with the schists, all striking parallel to the longitudinal axis of the belt. At intervals for a distance of more than two miles massive ledges of hypersthene gabbro, similar to the Sudbury nickel-bearing irruptive, whose relations to the other rock masses were not clearly seen, but which occur at or near the western edge of the belt, are associated with a massive hard, dark-green diabase.

The belt, striking north-easterly, passes just to the east of Nibinamik lake, and should cross the Winisk river a few miles below the foot of the lake. Owing to the continuous drift covering no exposures of rock in situ were seen along this section of the river.

The most westerly route traversed ascends the Pusabiwan river, a tributary entering the Attawapiskat from the north at the foot of Kabania lake. For the first few miles to the north of the river no exposures of hard rock are seen, the surface consisting of rolling hills of sand and clay. Beyond, though the country is for the most part drift covered, numerous outcrops of biotite gneiss, flat-lying or gently undulating, are seen along the river and lake shores to the height-of-land separating these waters

from those of the Michikenopik brook flowing into the south end of Weibikwei lake. Northerly from here the route follows a series of small lakes lying near the heads of streams flowing north-easterly into the Winisk for a distance of twenty miles. Large areas of muskeg, and low sandy flats occupy the greater part of the area traversed, diversified only by sand, gravel, and boulder ridges, that nowhere rise to elevations of more than eighty or ninety feet above the general level.

The second route, leaving the north-westerly bay of Lansdowne lake by a portage over a low ridge of unassorted sand, gravel and boulders, ascends a small brook through a series of lakes situated along its course, for a distance of eight miles, to a divide between the Attawapiskat and Winisk watersheds.

Occasional outcrops of biotite granite-gneiss lying at low angles are seen to within about three miles of the height-of-land, beyond which, after a short interval completely drift covered, exposures of massive diorite, and hornblendic and chloritic schist are seen, for a distance of about four miles. These, without doubt, are extensions westerly of the belt of these rocks described in connection with the first route as crossing a short distance to the north of Attawapiskat lake.

Continuing north the route follows a small stream downwards to Mameigwess lake, a body of water covering a considerable area, but of very irregular outline, and broken by many islands and long points.

Biotite gneisses are the only outcrops that show through the drift deposits covering the greater part of the surface. From the foot of Mameigwess the route follows a number of small lakes to a small stream, which it descends to a southerly channel of the Winisk river, fifteen miles below Wapikopa lake. Biotite gneisses only are exposed all the way through to the main river.

Routes Between the Winisk River and Trout Lake

Two canoe routes between the upper waters of the Winisk and Severn rivers were explored. The most westerly of these leaves the Winisk at Misamikwash lake, and the other at the first northerly expansion above Nibinamik lake.

Descending a small outlet that flows through a boulder-choked channel from the north-easterly bay of the lake, the first-mentioned route follows this stream—that by the addition of tributary brooks gradually becomes a river of considerable volume—northwards for fifty miles to a small lake known on the old maps as Sturgeon lake. For this distance the channel has a steep gradient, and the route is impeded by frequent rapids. Several lakes occur along its course, the largest, ten miles long and a mile and a half wide, lying not more than two miles to the north of Misamikwash lake. The country is generally low and drift covered, with only occasional exposures, all, excepting a few isolated outcrops of hornblende schist near Kingfisher lake, of biotite granite-gneiss.

From Sturgeon lake, a small tributary from the west, draining a chain of small lakes with connecting rapids, is ascended for thirteen miles to the divide. The rapids are many of them rough, and all are shallow, so that the stream is navigable with difficulty even by light canoes. The obstructions are caused by erratics that have been washed out from boulder and gravel ridges that cross the stream at frequent intervals. From the divide, Nemeigusabins lake and its outlet, a small stream with many rapids, lead to the south-east corner of Trout lake. The shores of Trout lake in the vicinity of the mouth of Nemeigusabins brook and for eight miles or more westerly are generally low and boulder strewn, the land back from the lake rising gradually over morainic ridges of gravel and sand. Occasional outcrops of banded biotite gneiss, well foliated and lying horizontally, or gently undulating, occur here and there in low, rounded exposures near the lake shores. Most of the country seen near the lake has been burnt over, and the present forest, over all but very wet muskeg areas, is a second growth of small size.

Avoiding the shallow streams between Sturgeon and Trout lakes an alternative route follows an almost direct line through nine small lakes or ponds, connected by ten portages aggregating a little over five miles and a half in length.

The section traversed is a nearly flat, sand-covered plain, with occasional low, drift ridges and extensive areas of muskeg.

The second route referred to follows the west branch of the Winisk down stream from Sturgeon lake for thirty-three miles in an easterly and then southerly direction, to a small lake, where the river changes its course to a northerly direction.

The country traversed by the river is similar to that crossed by the main Winisk in one of its most striking features, namely, the occurrence of parallel glacial ridges that deflect the course of the channel and of the lakes to a series of zig-zags conforming to the trend of the glaciation. The country is, however, more level and not so well drained as that bordering the main river; the proportion of swampy land is larger and the forest growth consists largely of black spruce and tamarack.

Leaving the west branch a short divide is crossed, and a stream, flowing south-

westerly, probably into one of the northern bays of Wunnummin lake, is ascended in a south-easterly direction through an almost continuous chain of lakes, with short rapid intervals of river joining them, for twenty-one miles, to a minor divide separating the headwaters of this stream from another small river flowing south-easterly to the Winisk above Nibinamik lake, a distance of thirty-six miles. The country is of the same general character, and the lakes, and to some extent the river channel, show the same parallelism to the glaciation, due as before to the ridges of transported boulders and gravel.

The covering of drift material is so universal, and the relief so small, that the underlying rocks can seldom be determined. Wherever outcrops occur they are biotite granite gneisses, so that if the Wunnummin lake belt of conglomerates and schists extends to this distance easterly, as would seem probable, they are entirely concealed by surface deposits, and cross the route at one of the long intervals without exposures.

Route Between the Albany and Attawapiskat Rivers[33a]

The route principally used between the Albany and Attawapiskat rivers leaves the former river at Eabemet lake and reaches the latter at Lansdowne lake, traversing a distance of seventy-five miles. The first thirty miles from the Albany through Eabemet, Rib and Kenozhe lakes to Machawaian lake was traversed by Dr. Bell in 1886, and has been described by him in his report on "An Exploration of Portions of the Attawapiskat and Albany Rivers," published by the Geological Survey in 1887. The belt of diorites and felsitic, chloritic, and hornblende schists that crosses the Albany river at Petawanga lake crosses this route just north of Eabemet lake, in a band about nine miles wide, running N. 70° E. For the balance of the distance to Lansdowne lake, wherever outcrops are seen they are of biotite granite-gneiss of medium grain, striking about east and west, and banded fine black biotite gneiss cut by a coarse gneiss that encloses blocks of the finer.

From the north-westerly bay of Machawaian lake the divide between the Attawapiskat and Albany waters is crossed, at a distance of two miles to the north of the lake, by a portage seventy-four chains in length, traversing a muskeg with occasional ridges of transported gravel and boulders.

Manitush lake, two miles long, lying at the north end of the portage, discharges northerly by a small stream, barely navigable by canoes, into Marten Drinking river, which the route follows through Hail lake to Wintawanan lake, from which there is a route westerly through an intervening small lake to the south branch of the Attawapiskat river at Ozhiski lake. The Marten Drinking river, rather shallow and with a number of rapids along its course, is nevertheless navigable by canoes down to its mouth at one of the southerly bays of Lansdowne lake. The country between the two rivers in the neighbourhood of the route is a high, rolling plateau, rising, midway, about a thousand feet above the sea, or a hundred feet above the Albany at the point of departure. Large areas of muskeg abound, from which rise low, rounded bosses of gneiss, and ridges of sand, gravel, and boulders.

To the west of Machawaian lake the country is much more broken and rises to higher elevations. This more elevated region extends in a belt westerly past Trout and Cedar lakes, and without doubt continues still farther west, forming the height-of-land between the Albany and the south branch of the Attawapiskat. This country is referred to in the description of the route down the Kanuchuan river on a previous page, where the hills are stated to be composed of transported material to their summits.

Cultivation of the Land

In the matter of the actual cultivation of these northern areas we have little to go upon. At the Hudson's Bay Company's posts at Fort Hope and Osnaburgh potatoes have been grown, and small gardens maintained from the time of the establishment of the posts, and little difficulty has been experienced in maturing the common garden vegetables of Ontario, though occasionally the frosts of late summer have cut off all but the hardier kinds. As the posts were located with a view to their favourable situation for the purposes of the fur trade with the Indians, neither one is situated on ground well suited for cultivation, and much better results might reasonably be expected were trials made on more favourably situated tracts.

An Indian cultivating a small garden plot at the head of the Pineimuta branch of the Attawapiskat river succeeds in raising good crops of potatoes and turnips.

Fish

Whitefish and sturgeon are the best food fishes, and occur in most of the lakes. Both are taken in nets, and the latter also by spearing from scaffolds built out over rapids in the rivers. Doré and pike are also generally distributed over the whole area,

33a. See maps, pages 68 and 72.

and form an important source of food supply, though the sucker among the fishes, like the rabbit among the mammals, holds the most important place, as it can be caught everywhere, not only in the larger lakes but also in the smaller ponds and streams.

Brook trout were actually caught only in the Winisk river near its mouth, and in the streams running into the Albany river, but were seen in the rapids below Weibikwei; the Indians assert that they occur also in the lake itself.

Lake trout were caught in large numbers in Trout lake at the head of the Severn river, but are not found in either the Winisk or Attawapiskat waters.

Wild Animals

The moose (*Alces americanus*) has been found as far north as the southern shore of Weibikwei lake, in N. lat. 52° 50′, though tracks were actually seen during our exploration only as far north as the Attawapiskat river. Even here it is not nearly so plentiful as farther south in the belt of country lying near the Canadian Pacific railway and extending for about 150 miles north of it.

Caribou (*Rangifer caribou*) range all over the district.

No red deer are found anywhere throughout the region.

The fur-bearing animals, though not so plentiful as they once were, are still fairly abundant throughout the district; the otter and the beaver from long-continued trapping are less numerous, perhaps, than any other species.

Bears (*Ursus americanus*) seem to be able to hold their own pretty well, and are still taken in good numbers. There is probably but one species of the common black bear, though the Indians and traders differentiate from this the brown bear, which they claim differs from the black, not only in colour and size, but also in disposition and habits.

Wolves (*Canis lupus*), though scarce, are not unknown.

Foxes (*Vulpes vulgaris*), including the red, silver, black and cross varieties, are numerous, though they vary in numbers with the periodic increase and decrease in the the numbers of the hares.

Lynxes (*Lynx canadensis*) are fairly plentiful.

Otters (*Lutra canadensis*), and Pine martens (*Mustela americana*), are taken in good numbers, and beavers (*Castor fiber*) occur more sparingly.

Minks (*Putoris vison*), and muskrats (*Fiber zibethicus*), are plentiful. These with skunks (*Mephitis mephitica*), weasels (*Putorius vulgaris*), and wolverines (*Gulo luscus*), make up the number of the merchantable furs.

The rabbit (*Lepus americanus*) occurs abundantly all over the district, and is, perhaps, the most useful of all to the Indians, as it affords, during the winter particularly, both food and clothing.

That the raccoon occasionally strays as far north as N. lat. 52° is shown by the fact of one being taken by an Indian woman on the upper Attawapiskat river in 1903.

Indians

The Indians of the district, numbering about 700, are nomadic trappers, living principally upon fish, and obtaining from the Hudson's Bay Company, and to a smaller degree from other fur traders, the limited amount of necessaries that are not supplied by the country. A few have small huts built of logs, with fireplaces and chimneys of wattles and mud, in which they live for a part of the year, but the greater number content themselves with winter teepees constructed of poles covered with sheets of birch bark, and summer tents of cotton; indeed, house building is such an arduous task for the Indian that the traders in the district have a saying to the effect that as soon as an Indian completes a house he dies, this result being due, not to the unwonted labour involved, but to the arrival of extreme old age before the work is finished.

They are of the Ojibway tribe, though mixed to a certain extent with the Crees of the Hudson Bay basin, the purest Ojibway stock being found among the bands about the heads of the rivers. They seem to be men of larger frame than the Crees of the coast.

A greater proportion of nominal Christians are found among these Indians of the far interior than among those nearer the front, in the hinterland of Ontario. This result is due in about equal measure to the efforts of the Roman Catholic church, which maintains a permanent mission establishment at Albany, with an educational home for children, and sends visiting missionary priests periodically among the Indians of the interior; and to the Anglican church, which maintains the missionary diocese of Moosonee, by which resident missionaries are supported at various points in the interior region.

The Indians seem to accept readily the forms of Christian worship, and take great pride in their proficiency in memorizing the religious formulas presented to them.

The mode of life followed by these Indians offers great obstacles to the work of

the missionaries, who are able to reach them for purposes of instruction for only short periods during each year.

For the same reason, that is on account of their nomadic life, the teaching of the children can be carried on only in the same desultory way.

Notwithstanding these disadvantages, practically all the Indians can read and write the syllabic characters designed and introduced by James Evans, an early Wesleyan missionary among the Crees.

The introduction of this system of writing has proved a great boon to the Indians in their intercourse with one another. Written entirely phonetically it is unhampered by irregularities, and can be readily acquired by one Indian from another. So general is their knowledge of this sign language that every Indian camping-place, and every point where canoe routes diverge, become local post offices, where letters written on birch bark, often, of course, containing only an account of trivial occurrences, but giving the opportunity to convey news of importance, are left for the information of following parties.

Photo by W. McInnes
Winisk river Indians near Asheway.

It is very doubtful whether the Indian has advanced much in general prosperity from the days when he lived in primitive savagery. His teepee was the same then as now; his weapons are now more effective, but game is less plentiful; he wears better clothes, or clothes that one associates with civilization, but not probably so well adapted to his needs and way of living as his old raiment of skins. Even now he has to fall back upon rabbit skins, the only furs that he can afford to sacrifice to his personal use, for protection in winter. The skins are cut into strips, each skin, by being cut spirally, producing a continuous strip. These strips are sewn together at the ends, and twisted into ropes, which are woven loosely into blankets and rough coats that very effectually keep out the most extreme cold.

Fish are taken with net and spear, and in trap-weirs. These are constructed of spruce poles driven in a line into the bottom of streams, and interwoven with twigs so as to fence off the greater part of the water, and force it to run in volume only through a gate arranged so that the water flowing through the opening quickly drops away through the interstices of a platform of poles, leaving stranded all fish coming down with the current. One or two families will often camp by the side of one of these "mechiken" for weeks at a time, supplying their wants entirely from the stranded fish, and smoke-drying any surplus collected. This is accomplished by simply stringing the split fish on poles and hanging them in the smoke-laden atmosphere of the teepee. The fat dropping from the fish in drying is carefully collected and preserved for future use in bags made of the skins of embryo rabbits, the bladders of pike, or in similar receptacles ingeniously improvised from the materials at hand.

Wild rice, a staple among the Indians farther south, is too rarely met with throughout these northern regions to form any part of the Indian's food supply, and to supplement his diet of fish and flesh he has only the various berries in their seasons and the small amount of flour that he is able to buy from the trader in exchange for his surplus furs. For tea, when the imported article is not available, the small twigs of the trailing red cedar are used.

Taken as a whole, they appear to be a fairly healthy lot, though many suffer from diseases of the skin brought on probably by a too constant diet of fish. The greatest

Photo by W. McInnes.

Lower Winisk river, showing banks of Silurian Limestone and characteristic Forest.

mortality is caused by pulmonary diseases, to which they are very prone, and to the occasional outbreak of epidemics of measles, etc., that sometimes prove widely fatal. They are far from cleanly in their personal habits, a few weeks' residence at a place in the summer time generally rendering it no longer habitable by reason of the accumulated filth.

With the exception of occasional small log huts, the Indians of the region dwell in teepees covered with birch bark, though the cotton tent, made from materials bought from the traders, is now widely used during the summer months. Near the mouth of the Winisk river, many miles north of the ranges of white birches, a winter teepee, made after the plan generally used for birch bark wigwams, was covered with blocks of moss cut from the muskeg.

Archaeology

Chipped flints were found in numbers scattered along the beach of an island in Attawapiskat lake. Two fairly perfect arrowheads were found at the same place, one chipped from white quartz and the other from flint, derived apparently directly from

the drift, where it occurs as small boulders which have been carried primarily from the nodular beds in the limestones of the Hudson Bay basin.

At camping-places of the Indians broken specimens of *Pecten islandicus* were noticed among the debris of the camps. These shells occur in a very perfect state of preservation in the marine clay, and are still used by the Indians along the river as very convenient substitutes for spoons.

Forests

The average size of the trees growing within the country explored is not great. On exceptionally favourable tracts the spruces attain sizes quite large enough for commercial use as sawn lumber, and large areas would afford good pulpwood. Evidences of the constant recurrence of forest fires over the area are everywhere plainly seen. The brulé areas, varying from quite small patches to large tracts, are of every age; some are so old the forest has attained the full height of the old growth and the newer age of the trees can only be ascertained by a reference to their rings of growth, and others so recent that no vegetation covers the blackened surface. These fires are generally the result of the carelessness of Indian travellers, but may sometimes be traced to the igniting of a dry, standing tree-trunk by lightning. The oldest trees found in the whole area were growing on a till-covered island, about fifty miles from the mouth of the Winisk river. The complete isolation from the mainland by broad channels ensured its protection from fires having their origin outside its own borders. The spruces growing here were found by their rings of growth to be between 270 and 280 years old. The diameters and ages of trees, growing in a number of different localities throughout the region, were noted, and are given in the list below:—

			Diameter in inches three feet from ground.	Age, by rings of growth.
Tamarack,	Winisk river,	32 miles from mouth	9	100
Black spruce	"	32 "	12	125
"	"	32 "	12	153
"	"	32 "	8	75
"	"	50 "	10	275
"	"	65 " near bank.	8	130
"	"	65 " "	6	115
"	"	65 " 10 chains back	3	105
Tamarack	"	65 " "	3	80
Black spruce	"	below Wapikopa lake	10	130
"	"	Wapikopa lake	9	145
"	"	"	6	135
"	"	Nibinamik lake.....	9	75
"	"	"	5	75
"	"	above Nibinamik lake	15	130
Aspen poplar	"	" "	15	130

The rings show that the growth is generally rapid for the period between five and thirty years, and afterwards exceedingly slow.

The northern limit of a number of the common trees of northern Canada falls within the district, and of one species both the northern and southern limits.

There is a black birch that the Indians call the squirrel-bark birch. Specimens of the wood and foliage of this tree were submitted to Professor John Macoun, by whom they were forwarded to Dr. Sargent, of the Arnold Arboretum, for determination. Dr. Sargent has named this birch *Betula fontinalis*. It was not seen growing in abundance anywhere in the district, though occasional trees were noted at various points between the Albany and Winisk rivers, the most southerly occurrence being in N. lat. 51° 28′, on Dog-hole brook, flowing into Lake St. Joseph, and the most northerly in N. lat. 52° 40′, on the Wapitotem river, flowing into Weibikwei lake, on the Winisk river. The largest tree noticed had a diameter of six inches at three feet from the ground, and a height of about thirty feet. Where seen it was growing near the banks of rivers or lakes, in moist localities. A table is subjoined of the observed northern limits of a number of species.

Northern Limits of Trees

White elm, *Ulmus americana*, Albany river	N. lat.	51°	30′
Black ash, *Fraxinus sambucifolia*, Eabemet lake	"	51°	50′
Mountain maple, *Acer spicatum*, between Attawapiskat and Winisk rivers	"	52°	25′
Mountain ash, *Pyrus americana*, between Attawapiskat and Winisk rivers	"	52°	38′
Banksian pine, *Pinus banksiana*, Weibikwei lake	"	53°	
White cedar, *Thuja occidentalis*, Weibikwei lake	"	53°	05′
Balsam spruce, *Abies balsamea*, Winisk river	"	54°	15′
Canoe birch, *Betula papyracea*, Winisk river	"	54°	25′
Aspen poplar, *Populus tremuloides*, Winisk river	"	54°	45′

The northern limits of balsam poplar, tamarack, and black and white spruce lie beyond the mouth of the Winisk river, the most northerly point examined.

Photo by W. McInnes.

Lower Winisk river.

Climate

The climate, as would be expected in these latitudes, and in a wilderness country approximately a thousand feet above sea-level, is somewhat severe. The summer temperature, though on occasional days rising as high as 85° Fahr., averages very much lower, and the nights are, practically, always cool. Frosty nights often continue into the early summer, and recur again in the autumn before most grain-crops would be ready for harvesting. Temperatures were taken with the thermometer during two seasons, and these, averaged, gave the following results for the months of July and August on the lower Winisk river, and for July, August and part of September on the upper Winisk and upper Attawapiskat rivers:—

	6 a.m.	noon.	6 p.m.
Lower Winisk river	57°	69°	57°
Upper Winisk and Attawapiskat rivers	47°·5	61°·6	58°

The only points in the region where any attempts at cultivation of the land are made are the two Hudson's Bay Company's posts at Osnaburgh, near the foot of Lake St. St. Joseph, and at Fort Hope, on Eabemet lake.

At these posts small kitchen gardens and potato-fields are maintained with some success, though neither place is favourably situated for the purpose, the soil in both cases consisting of an almost pure sand. Timothy and clover grow luxuriantly, and all the common garden vegetables thrive at both places. Indian corn, however, is not sufficiently filled out for table use when caught by the frost. Barley has been successfully grown at Osnaburgh, and the potato crop, wherever a suitable tract of land has been utilized, has been generally fairly good at both places.

The first killing frost in 1903 occurred on the night of September 3, and in 1904 on the night of August 30.

The temperature of the water in a number of the larger lakes and rivers was taken by thermometer at six inches below the surface, and is given in the following very uniform list:—

Water Temperature

Lake St. Joseph, Albany river, June 28	59½°
Annimwash lake, Albany river, July 5	58°
Kagabades-dawaga lake, Attawapiskat river, July 16	62°
Attawapiskat river, August 8	60°
Weibikwei lake, Winisk river, August 9	62°
Nibinamik lake, Winisk river, August 23	58°
Winisk river, August 24	57°

Land Shells

A small collection of land shells, made during the summer of 1904, has been examined by Dr. Whiteaves, who enumerated the following species. It was noted that in actual number of individuals there was a decided and progressive decrease as the latitude increased:—

Vertigo ovata, Say.
Conulus fulvus (Müller).
Zonitoides arboreus (Say).
Vitrea hammonis ? (Ström).
Pyramidula striatella (Anthony).
Succinea vermeta, Say.
Succinea retusa ? Lea.
Succinea ovalis, Gould, non Say.

Freshwater Shells

Collections of the freshwater shells of the region were made each year and submitted to Dr. Whiteaves for determination, who has furnished the subjoined list, which for convenience has been tabulated according to watershed areas:—

List of Freshwater Shells collected by Mr. W. McInnes in 1903-4-5 on the Winisk, Attawapiskat, and Albany Rivers, on the Root and English Rivers, near Lac Seul, and on the Severn River at Trout Lake.

By J. F. Whiteaves.

	Winisk River.	Attawapiskat River.	Albany River.	English and Root Rivers.	Trout Lake, Severn River.
Lampsilis luteola, (Lamarck)	*	*	*		
Anodonta marginata? Say	*	*			
Anodonta fragilis, Lamarck					
Anodonta Kennicottii? Lea	*	*	*		
Sphærium simile, Say		*			
Sphærium Walkeri, Sterki		*			
Sphærium emarginatum, Prime		*			
Sphærium stamineum, Conrad		*			
Sphærium (Musculium) secure, Prime		*			
Sphærium (Musculium) partumeium, Say		*			
Sphærium flavum, (Prime)				*	
Sphærium rhomboideum, (Say)			*		
Sphærium striatinum, Lamarck	*				
Sphærium—				*	
Pisidium compressum, Prime	*	*			
Pisidium altile, Anthony					
Pisidium fallax, var. *errans*, Sterki		*			
Pisidium variabile, Prime		*	*		
Pisidium affine, Sterki		*			
Pisidium Sargenti, Sterki		*			
Pisidium Mainense, Sterki			*		
Pisidium abditum, Haldeman			*		
Pisidium Roperi, Sterki			*		
Pisidium politum, Sterki				*	
Pisidium rotundatum, Prime			*		
Pisidium pauperculum, var. *crystallense*, Sterki				*	
Pisidium vesiculare, Sterki			*		
Pisidium splendidulum, Sterki, var.		*	*		
Pisidium scutellatum, Sterki		*			
Pisidium medianum, Sterki			*		
Pisidium milium, Held, Small var.			*		
Pisidium milium, Held, Small var.		*			
Pisidium sp. nov?		*			
Pisidium—? (near *P. abditum*)		*			
Valvata tricarinata, Say	*	*	*		
Valvata sincera, Say		*	*		
Amnicola limosa, Say		*	*	*	
Limnæa megasoma, Say			*		
Limnæa stagnalis, L.	*	*	*	*	*
Limnæa stagnalis, appressa	*	*	*		
Limnæa palustris, Müller	*				
Limnæa catascopium, Say	*	*	*		*
Limnæa galbana (Haldeman) Dall.	*				
Planorbis trivolvis, Say	*				
Planorbis corpulentus, Say				*	
Planorbis bicarinatus, Say	*	*	*		
Planorbis companulatus, Say	*	*	*	*	
Planorbis albus, Müller	*	*	*		
Planorbis hirsutus, Gould					
Segmentina armigera, Say		*			
Physa heterostropha, Say	*	*	*	*	
Ancylus parallelus, Haldeman				*	

REPORT ON A SURVEY OF

THE EKWAN RIVER

and of the Route through

SUTTON MILL LAKES NORTHWARD[34]

By D. B. Dowling

The country included in the angle between Hudson bay and the west shore of James bay is drained by several large streams running mainly to the north-east. Those entering James bay incline to the east after running north-east for a large part of their courses. The whole surface slopes gradually to the north and east, and the greater part of it is covered by a heavy deposit of clay and sand. On the north slope, or that lying south of Hudson bay, proper, the deposit is thicker than on the slope to James bay. On the Fawn river, a branch of the Severn, Mr. Low reports[35] high cut banks of clay near the junction with the Severn, which are as much as two hundred feet above the stream.

In the valley of Sutton Mill lakes there is a heavy cut, such as that mentioned by Mr. Low on the Fawn. The lake is very deep for its width, and the banks, where they are of clay, are 100 feet above the water, while several soundings in the lake give a depth of over 200 feet. The submersion of much of this area has been proven by the presence of salt water shells in the surface deposits.

On the Attawapiskat river, Dr. Bell does not mention such an accumulation of drift, while our own observations on the Ekwan show that the general depth of the drift covering is about 100 feet.

Elevation and Drainage

The recent uplift of the land, as observed by Dr. Bell in several places to the south of this, is as much as 500 feet. At the highest point reached by the marine terraces in the vicinity of Sutton Mill lakes the elevation was determined by simultaneous readings of aneroids at the lake and on the shore of Hudson bay at the mouth of Trout river. The western limit of these clays on the Albany river is below Marten's falls and on the Attawapiskat near the mouth of the Black Fence river. On the Ekwan, the edge of the deposit was not reached, and on the Severn, the marine clays were found on the Fawn branch near the first outcrop of Laurentian rock. At the period of greatest submergence the sea covered a large part of the area under discussion, but it is quite possible that part of the elevated ridge, consisting mostly of Cambrian rocks, in the latitude of Sutton Mill lakes, was either out of water or formed shallow reefs or a chain of islands.

On the removal of the great mass of the glacier and the consequent inauguration of the retreat of the sea and elevation of the land, the former lines of drainage were more or less blocked by the deposit left by the glacier and a new system of drainage was consequently formed. That some of these streams changed their courses as the upward tilting of the land took place is very probable. In the case of the Ekwan, the upward tilting to the north caused the deflection of the stream from the valley through which it ran on its way to the sea to the north of Sutton Mill lakes. The deflected part of the river is now the section below the Little Ekwan, and is noticeable as being much newer than the upper part.

The general surface is very even on that part covered by the marine deposit, and is a gently sloping plain covered for the most part by a thin forest of black spruce and tamarck. In the river valleys, especially near the streams, other trees occur, notably the poplars (*Populus tremuloides* and *P. balsamifera*) and birch. In the case of the latter tree, few large ones occur north of the Albany river, and the Hudson's Bay Co. have established a canoe-building industry at Albany post to supply the Indians coming from farther north. On the Ekwan, a solitary birch was seen, and that was only a small sapling on one of the islands. Five individuals of the Banksian pine were seen in one group on the north bank fifty miles up the river, so that the northern limit of both birch and Banksian pine may be said to be south of this stream. Poplar follows the valleys of the streams nearly as far north as the spruce. The country behind Cape Henrietta Maria is treeless, as is also a strip of the coast both to the south and the west of the cape.

A micrometer survey of the Ekwan river was made to the mouth of the Washagami branch, a distance of one hundred and fifty miles. The general valley is a narrow cut through clay, with cut banks on either side for most of the distance to the first branch.

[34] This report forms Part F, Vol. XIV., of the Geological Survey of Canada. In addition to Ekwan river and Sutton Mill lakes, it describes part of the west coast of James Bay. The preliminary or summary report on the territory is contained in Part A, Vol. XIV., pages 110-117. The exploration was made in 1901.

[35] Annual Report Geol. Surv. Can., Vol. II (N.S.) 1886, p. 18 F.

The country on either side is covered by a mossy swamp with a sparse growth of black spruce and tamarack. The course of the river, from the mouth of the Washagami, is east-south-east, but above this it evidently takes another direction, changing its upward course toward the south, and, as its head-waters lie between the heads of the Attawapiskat and Winisk rivers, it probably flows to the north-east for some distance before turning to the east. The upper part is an older channel, and its course, as before mentioned, was probably through the Sutton Mill lakes valley to the shore of the bay, which was at that time not so far from the lake as at the present time. In the latter part of its course, it is now cutting down a new valley threugh marine clays which cover the underlying rocks to a depth varying from twenty to fifty feet. From the lowest rock exposure to the sea, the current is swift and it is constantly moving a large quantity of gravel and finer material towards its mouth, and into the bay into which it empties. Limestone in apparently horizontal beds is exposed at intervals in that section which lies between forty and one hundred miles from the sea. From the fossils collected it would appear that they are probably of Silurian age.

Ekwan River. Photo by D. B. Dowling

Above the Little Ekwan, the river issues from a wide valley which is cut through a higher plateau, but this valley gradually narrows before the Washagami is reached, and cut banks of clay, higher but somewhat similar to those in the river below, occur at many of the bends. These clays contain marine shells such as *Saxicava rugosa*, *Macoma calcarea*, *Mya truncata* and *Cardium ciliatum*. These were also found about 390 feet above tide at the highest point at which the clays were seen. In the bed of the river the living fresh water species noticed were:

Anodonta Kennicotti, Lea, *A marginata*, Say, and *Lampsilis lutcolus* (*Lamarck*) var., as identified by Dr. Whiteaves.

The Washagami river is but a small stream, divided a few miles from the Ekwan into two branches. The northern branch comes from a long lake-valley running north and south, or parallel to that of Sutton Mill lakes, and this may also have been one of the outlets for a stream such as the upper part of the Ekwan. The lower part of this valley, or the portion near the Ekwan, is now being cut into by the stream and a short new valley eroded.

The fall in the Ekwan from the mouth of the Washagami, as given by our barometric readings, is over 300 feet. North of this, to beyond Sutton Mill lakes, extends a plateau

which is at an elevation of 400 feet above tide. Through this, in latitude 54° 20′, rounded or oval masses of trap protrude to a height of from fifty to one hundred feet. Through the plateau, on a line where there is also a break in the trap rocks, a deep narrow valley has been eroded in a north and south direction, which is now occupied by the waters of Sutton Mill lakes. At the lake the surface of the clay plain is 390 feet and the surface of the water of the lake is 290 feet above tide. Soundings show that the bottom of the southern part of the lakes is 310 feet below the plain and that of the northern part 250 feet below this datum, or only forty feet above tide.

Silurian limestone is found on Trout river, which drains Sutton Mill lakes, and is also found in the bed of the lake just north of the trap rocks. The rocks at the narrows of the lakes are cliffs of trap one hundred and fifty feet high, capping beds probably of Animikie age. These are dark slates impregnated with iron ore and interbanded with beds of jaspilyte. Some of the beds contain a high percentage of magnetite. On the east shore a section of about ninety feet of these jasper and iron-bearing slates is exposed above the lake, but on the west side they have been brought down to below the water level by a series of north and south faults, and the exposures there are of trap alone. These rocks form an east-and-west ridge reaching to the upper lakes on the Washagami, and eastward to a large lake on a branch of the Trout river, which, as before stated, drains Sutton Mill lakes and runs to the north. The slates and jaspilyte or jasper-sandstone beds form a long anticline, whose axis runs east-and-west, and the majority of the beds exposed belong to the northern slope of the anticline. This ridge is terminated on the lake by a series of north-and-south faults with downthrow to the west of unknown amount. The overflow of trap appears to have been at a later date, as there seems to be some unconformity at the base of the trap, the flow having filled all the inequalities in the underlying surface. The cliff at the west side of the narrows is of trap, one hundred and fifty feet high, with none of the jaspilytes showing beneath it. On the east side, however, ninety feet of these beds are exposed, with a varying thickness of trap above them.

The James Bay Shore

The shore of James bay is low and shallow, and a short description as given in the summary report is here added. The delta at the mouth of the Moose river is divided into three channels which enter James bay. The northern one runs from the north of Middleboro island to the north-west of Ship Sands, but it is nearly dry at low water and is also impeded by large boulders, so that it is not used except by canoes and small boats. The southern channel is also reported to be shallow. The central channel, which runs along the south edge of the Ship Sands, shoals to seven feet at low tide, and vessels pass at high water after having been lightened to draw about twelve feet.

Northward from the outer bar to North point, the water is very shoal, but it deepens slightly to Nomansland. The low-tide flats are not very wide, but bars project from many of the points for long distances, as at Long Ridge and Cockispenny points. At Halfway point, limestone fragments are pushed up along the shore from rock apparently *in situ* below tide. Long Ridge point is built up mostly of gravel, with a few boulders showing on the surface. From Nomansland to the Albany river the shore is very flat, and at low tide the mud shoals extend out for several miles.

The Albany river, like the Moose, is divided at its mouth into three channels. The trading establishment and mission are situated on an island on the north side of the southern channel. North of this island is the broad opening, called locally, North river. This has a long bar at its mouth, similar in position to the Ship Sands at Moose. The southern entrance to this is the larger, and it seems to be much deeper than the channel going to the settlement. The small channel north of the bar is shallow at low water and has a bar outside on which we found a depth, at high tide, of very little over one fathom. Very shoal water, in which boulders appear, extends northward beyond Nottashay point and boats are obliged to keep nearly out of sight of land to escape the shoals. Chickaney river, which enters north of the Albany, is said to be another channel from the same river.

Shoals were observed well out from shore to near the Kapiskau river. In the inner water between Akimiski island and the mainland there seems to be a maximum depth of about two fathoms. This shoals gradually to one fathom at a distance of three miles from either shore. The mainland is generally without a beach and between the woods and the tide-line is a wide flat covered with grass. The north-west part of Akimiski island approaches the mainland much closer than is shown on the maps, and a number of shoals are scattered from hence to the point south of the Ekwan river. The boat channel, according to our guide, runs to the west of the two islands which here lie off the shore. The position of the mouth of the Ekwan river, according to several observations, is in latitude 53° 14′ 0″.

Northward from the Ekwan, the shore, for a long distance, is flanked by high gravel bars, but at low tides a broad belt of mud extends out several miles, so that travelling

along this coast with canoes is very unpleasant should the time of high water be in the middle of the day or night. Landing on the beach without a long "carry" through the mud is only possible at high tide.

The rivers that enter the bay between Niahkow point and Cape Henrietta Maria are not large, and, as the former maps are mere sketches, it is difficult to locate those which are not known by a local Indian name. The first stream north of the Ekwan is a small channel said to be a branch from that river. It is marked by two gravel bars to the north about a mile from from the beach. Swan river, which is perhaps Raft river of the map, enters in latitude 53° 36′. It is in a slight bay or curve in the shore line. In latitude 54° the shore takes a curve to the west, forming a point, and, as the tree-line curves to the north-west from here, this is probably Point Mourning, the first wooded point south of Cape Henrietta Maria. Several small streams flow into this bay. The first is called by the Indians, Nowashe river—the next Patchipawapoko—then the largest along this coast, the Opinnagan, followed by the last stream, Nikitowasaki, fifteen miles north of the Opinnagan. The latitude of the mouth of the Opinnagan river, by observation, is 54° 12′ 24″.

The bay to the south of Cape Henrietta Maria is shallow and muddy with wide mud flats, but near the extreme eastern end of the cape the shore is reported to be bolder, and limestone beds are said to outcrop at high tide mark. These are probably continuations of those found on the Ekwan and Attawapiskat rivers to the south-west.

The timber along the coast gradually becomes smaller in going northward and the tree-line recedes from the shore, leaving it finally at the Opinnagan, so that the country behind the cape is more or less an open plain. The shore, where the trees are at a distance from the beach, is generally an even mud slope, covered above high tide with grass, followed by a wide belt of stunted gray willows which give an appearance like the sage bush of the plains. Behind this, a few isolated spruces of small size appear before the tree-line is reached. In sailing along this coast, it is impossible to know which way to steer so as to run parallel to the land, as nothing is to be seen ahead by which to shape one's course.

Tides, Fur-bearing Animals and Game

The tides along this narrow shore are not regular in their amount of rise and fall, which is determined in a great measure by the direction and strength of the wind. From the Ekwan river northward, the high tide appears to be about six and a half hours after the moon's meridian passage—the flood and ebb running seven and five hours respectively, while to the south of the shallow ground between Akimiski island and the mainland, the flood comes from the south and is much earlier. High tide at Lowasky river occurs at between two and a half and three hours, and at Albany about the same. The flood tide at Lowasky river runs four hours and the ebb eight. At Albany the flood runs five hours and the ebb seven. At the outer bar at Moose river the tides are from half an hour to an hour earlier.

Fur-bearing animals are not particularly numerous, but the Indians bring in to the Hudson's Bay Company's posts, fox, otter and beaver. Caribou are occasionally secured, but not in large numbers. Black bears are also occasionally killed. Last season (1901) I was informed that the Indians on Akimishi island killed three white or polar bears during the early summer, and one was seen by our party along the coast north of the Ekwan.

In the interior, the game birds are all very scarce, the fall hunt for ducks and geese being confined to the shores of the bay. The rivers afford a limited supply of whitefish, and a small species of this fish is caught in the tide-water along the west shore of James bay. The nets are set or hung on stakes on the tide flats, and are covered by the tide for a few hours each day. Sutton Mill lakes are well supplied with a slender variety of gray trout and the streams running to the north into Hudson bay are, at certain seasons, well stocked with brook trout. In August the stream draining Sutton Mill lakes was full of these fish, and several fine specimens were caught on the lake above at the narrows.

Historical Summary

The southern coast of Hudson bay, east from Port Nelson (York Factory), was visited or explored by Captains Luke Fox and Thos. James in 1631, and again visited by James in 1632. These two navigators met off the coast near the mouth of the Winisk river on August 29-30, 1631. Each had given a name to the country to the south-west. Fox called it "New Yorkshire," and James "The South Principality of Wales," probably on account of the previous name "New Wales" given by Button in 1612 to the land south-west of Port Nelson. These two navigators sailed together eastward to the entrance to James bay and there separated, Fox to go north, and James southward into the bay to winter. Fox called the cape he had left "Wolstenholmes Ultimum Vale." James, after rounding the cape, determined its latitude (55° 05′) and called it Cape Henrietta

Maria, after the queen and also after his own ship. His name for the cape has been retained, and his description of the coast near it is still very true and is in a concise form[35]:—"From Port Nelson to this cape the land trends (generally) east-south-east, but makes with points and bays, which in the particulars doth alter it a point, two, or three. The distance is about one hundred and thirtie leagues. The variation at the cape, taken by Amplitude, is about sixteene degrees. A most shoald and perilous coast, in which there is not one Harbour to be found."

He did not follow the shore far to the south of the cape, but made out to the Bear islands and so on to the south end of Charlton island, where he wintered. Returning in the summer (1632) he landed at the cape and set up a cross with the arms of the king and of the city of Bristol.

The eastern face of the point seems to have deeper water off it than along the north shore, as James anchored in six fathoms about a mile from the shore. He reports a long shoal point running out to the northward or north-east.

In a publication by the Haklyut Society, entitled "The Geography of Hudson's Bay," by Capt. Coats (an officer with the H. B. Co. from 1727-1751), the description of the coast from the Severn river to Cape Henrietta Maria is written for the information of sailors, but in it is given some indication of the character of the land as well. The following extracts from the above work give the main part of Coats' description (*see* pp. 46-52).

"From Severn river to Cape Henrietta Maria, in latitude 55° 10′ N., the course is E.S.E., to westward of which in 55° 30′ near Cape Lookout is some broken ground, banks and ridges a great way off, come no nearer than seventeen fatham; the land very low and fenny, appears here and there in tufts of tree.

"To southward of the Cape the land runs S.S.E., very low but clean even soundings with wood in some places. The shore is flatt a good ways off."

". . . . Near the same latitude (54° 38′ to 54° 28′) on the west main is a bluff of wood, called Point Mourning, from the burying of one of Captain James' men there. The land to northward of this, and westward of the cape, is all a low fenny unbounded marsh, not to be seen but in fine weather, so your lead is your principal guide."

The topography of this coast and of the western side of James bay has been but roughly sketched by these navigators, and little altered by subsequent ones. The streams draining to Hudson bay, as also those flowing eastward, were mapped from sketches made by various officers of the Hudson's Bay Company. The route through Sutton lakes, by the Little Ekwan river, was sketched by Mr. Thos. Bunn in 1803. Later, a route to the Winisk *via* the Washagami branch of the Ekwan was mapped from a track-survey or sketch by Mr. Geo. Taylor in 1808. This latter route is not used by the Indians of the present day, as perhaps the streams to be navigated are too small. The Little Ekwan is now reported to be blocked up by driftwood and the old routes are totally changed. The route to the lake is now from the Washagami eastward over a long stretch of muskeg, and that to the Winisk is made by a portage from farther up the Ekwan, direct to a small stream, a tributary of the Winisk.

The information as to the origin of the topography which appeared on the old maps is obtained from a manuscript map compiled for the Hudson's Bay Company to show the explorations of Mr. Peter Fiddler. This is now in the office of the Geographer, Interior Department. These sketches were no doubt supplied to Arrowsmith and were since reproduced on all the maps of this district.

The Attawapiskat river at the southern boundary of this district was surveyed in 1886 by Dr. R. Bell, who the same year completed his survey of the Albany river. The same season Mr. A. P. Low traversed the country to the west from Lake Winnipeg to the Severn river and descended the latter stream to the sea. Instead of following the main stream for the whole distance, he crossed from Severn lake to Trout lake lying to the east and descended the eastern branch or Fawn river, joining the main stream about fifty miles from the sea.

Ekwan River

Of the many outlets at the mouth of this stream, the principal or that having the greatest depth of water is the central one. Several small wooded islands are situated at the mouth, and to the east of these the several branches of the stream flow over boulder and gravel flats to the sea. At high tide the level of the river is only affected as far up as the first wooded island, and at low tide there is about a mile of swift current from this point to the sea. Boats entering at low tide have only about two feet of water at the steepest slope. In the spring there is probably sufficient water to float boats drawing over four feet of water.

There is a strong current in ascending the river for the first eighty miles, and, in

[35] Voyages of Fox and James to the North-west. Haklyut Society, p. 490.

this part, the whole distance is usually made by tracking the canoes. In the present condition, the sides of the valley are generally free from bushes and trees, so that there is good walking along the bank.

After passing above the islands in the mouth of the stream, it is found that the river has cut down through a terrace of clay with a small percentage of sand and pebbles. The pebbles are generally found near the surface of the terrace—here about fifteen feet above the stream. The eastern edge of this terrace slopes steeply to the sea, and, as it is wooded to near high tide mark, scarcely any trace of it is seen from the sea. The tide flat which borders the coast is probably derived from the denudation of the edge of this terrace. The absence of cliffs or cut-banks along the coast would indicate a recently receded shore-line.

The surface of the terrace was found to be covered with a thick coating of moss, and the timber on it is mostly small spruce and tamarac. Some of the trees might be from six to eight inches in diameter, but the average is much less. At the edge of the bank a fringe of much larger trees occasionally appears, but it does not extend far from the stream. The exposures on the banks show the terrace to be made up mostly of strati-

Spruce on banks of Ekwan river. Photo by D. B. Dowling.

fied clay and sand, near the surface, with a fine clay of soft texture beneath. Of the boulders and pebbles in the channel of the stream and along the sloping banks, fully fifty per cent. are of light yellow-gray limestone and the remainder are of Huronian and Laurentian crystallines. Occasionally, bits of red quartzite and iron-bearing shales from the rocks of the Nastapoka group were seen. Large boulders of greenstone, having rounded inclusions of coarser texture and lighter colours, occur here as well as on most of the streams entering James bay. These are also probably derived from the amygdaloids in the upper part of the Cambrian sections found on the east side of Hudson bay.

Not far from the mouth, the river again divides into a number of channels, and the banks in this vicinity are only about ten feet high. The current increases slightly and several swift places are caused by an accumulation of boulders in the channel. A small branch channel, running north to the bay north of Niahkow point, leaves the river from behind some of the islands of this group. The river continues with swift current and is divided in a few places by islands.

Outcrops of Limestone

Thirty-three miles from the mouth, the first strong rapid occurs, and the underlying limestones outcrop, in a ledge running across the bed of the stream. The beds are lying apparently horizontal, and are of a grayish-white dolomitic limestone holding a few badly preserved fossils, from which Dr. Whiteaves describes or identifies the following:

Favosites Hisingeri; Trimerella borealis; Reticularia septentrionalis; Euomphalus sp. idet.; and *Bronteus Ekwanensis.*

In the next ten miles, which is the distance to the portage at a series of heavy rapids, there are two stiff rapids at which the limestones outcrop. At the heaviest of these, called the Middle rapid, the fall amounts to approximately five feet. The beds exposed here are thicker and contain many more fossil remains than at the first rapid. The fossils are principally large trilobites and corals, as in the following list: *Spirifer crispus; Reticularia septentrionalis; Salpingostoma boreale; Diapho. rostoma perforatum; Phragmoceras lincolatum; Illænus* sp. indet.; and *Bronteus Ekwanensis.*

Above this the banks gradually rise in a series of steps to thirty feet, which might be taken as an indication of an old shore line.

The portage mentioned above is on the northern side of the river. Here the stream has cut a shallow gorge through the limestone. This has been slowly widened, and is the first indication of age that the river thus far has shown. Below this, from the sea up stream, the river channel is new—that is to say, it is still wearing down the sides of the valley and is bordered by cut-banks. The material thus fed into the river is being rapidly removed, and there is little of it deposited till the sea is reached.

The rapids below the portage show a certain amount of river wear, but not so pronounced as at the portage. The beds cut are not deposited in a regular manner, but are disarranged owing to the local development of coral reefs, which give the immediately overlying beds the appearance of having been disturbed and bent. These same limestones on the Attawapiskat river, just to the south, are described by Dr. Bell as cavernous limestones. It would seem that the more porous, or what seem to be the coralline masses, weather much more easily than the thinner beds. On this river there are no caverns, as the valley is not eroded deeply enough to expose much of the rock. The beds below the coral reef at the portage are thin and lying nearly horizontal, but above the portage the beds are thicker and contain a very numerous assortment of remains of gastropods and corals. The collections made here for the purpose of determining the horizon were mostly from the rocks near the upper end of the portage road. The list of species determined or described by Dr. Whiteaves, and published as a supplement to this report, in his opinion indicates a horizon rather high up in the Silurian.

Those which occur at this part of the river are given in the following list:

Halysites catenularia; Lyellia superba; Zaphrentis Stokesii; Pycnostylus elegans; Pycnostylus Guelphensis; Favosites Gothlandica; Favosites Hisingeri; Stromatoporoid sp. indet.; *Crinoidea* sp. indet.; *Fenestella subarctica; Trimerella Ekwanensis; Strophodonta* sp. indet.; *Plectambonites transversalis; Spirifer* sp. indet.; *Reticularia septentrionalis; Meristina* (?) *expansa; Reticularia* sp. indet.; *Glassia variabilis; Atrypa reticularis; Camarotœchia Ekwanensis; Ambonychia undulata; Ambonychia septentrionalis; Mytilarca pernoides; Ctenodonta subovata; Euomphalopterus* sp. indet.; *Megalomphala robusta; Salpingostoma boreale; Gyronema speciosum; Gyronema Dowlingii; Gyronema brevispira; Loxonema* sp. indet.; *Orthonychia obtusa; Platyceras compactum; Strophostylus amplus; Strophostylus inflatus; Strophostylus filicinctus; Endoceras* (or *Nanno*) sp. indet.; *Kionoceras cancellatum; Orthoceras Ekwanense; Orthoceras* sp. indet.; *Phragmoceras lincolatum; Illænus* sp. indet.; *Bronteus Ekwanensis; Bronteus aquilonaris;* and *Ceraurus Tarquinius.*

For nearly four miles above the portage the current is swift and several small rapids occur, the largest of which has a fall of three feet. At thirteen miles from the portage is another rapid where the exposed rock is a thinly bedded limestone in a low anticline, the axis of which runs N.E. and S.W. A steady swift current is met all the way to Flint rapid, thirty miles above the portage, but the banks are in places partly overgrown with grass and the edge of the slope fringed with willow. Both species of poplar begin to make their appearance, and some trees are of fair size. In the lower reaches the banks are for the most part bare and of clay, with boulder pavements near the stream.

All the exposures of the clay contain marine shells near the top, from which the following species were collected: *Saxicava rugosa, Mya truncata, Macoma calcarea and Cardium ciliatum.*

No definite boulder clay was seen, as it is covered by the marine clay and the constant sliding from the surface conceals the underlying beds.

The Flint rapids are not more pronounced than many of the others, but as the river has cut partly through a series of beds of yellowish gray limestone, in which there are many inclusions of chert, the Indians have named the rapid "Piwana powestik," or Flint rapid.

The country on either side is about ten feet above the stream. Poplar shows in spots and occasionally clumps of large black spruce, but these are generally on the islands or prominent points of the river banks.

What is called Upper or Last rapid is a small fall of two feet, nine miles above Flint rapid, where the river flows over thin beds of limestone. The section of the rocks exposed consists of only a few beds, making a total of about six feet. The lower members are ashy gray in colour, somewhat mottled, and break into irregular lumpy fragments. A few fossils collected from these beds are given in the following list, from the appendix by Dr. Whiteaves.

Zaphrentis Stokesii; Favosites Gothlandica; Orthis sp. indet.; *Pleurotomaria* sp. indet.; *Actinoceras Keewatinense; Phagmoceras lineolatum; Isochilina* or *Leperditia* sp. indet.

The central beds are yellow and full of cavities of irregular shape, with a thickness of perhaps two or three feet. The top beds are gray and similar to those at the base. Fossils are scarce.

Gravel piled on upper end of island at last rapid, Ekwan River. Effect of ice shoving in spring freshets. Photo by D. B. Dowling

Above the rapid to the mouth of the Little Ekwan river, the valley is probably slightly older than below, and the banks are covered with willow and poplar. The channel is wide and dotted with numerous islands. In a few places side channels form large islands and the current in this part is much slower, averaging only about a mile and a half per hour.

Little Ekwan and Matiteto Rivers

The Little Ekwan enters from the north in a narrow valley. The stream appears to be very small and is reported to be blocked by drift timber and windfalls, so that the Indians do not travel on it with canoes. Just to the south is the mouth of the Wagakashi coming from the south in a valley which is a continuation of that of the Little Ekwan. Another stream from the south, the Matiteto, enters three miles above the Little Ekwan and there are several places in the stream between these two points where the current is swift. Here the river has cut a channel through thin bedded limestone and about a

foot of this shows on the banks. It is a fine-grained yellow limestone and shows no fossils. Three miles above the Matiteto, the same beds apparently are also cut by the channel of the river, and this is the highest point on the river where we saw the underlying rocks. These exposures no doubt formed rapids in the earlier history of the channel, but they have since disappeared, and the general grade of the river is now nearly reached, except at one or two points. Similar denudation is observed at Flint and Last rapids, but, as there is a heavier bed of limestone to cut through, there is still a large amount of work for the river to do. At the portage and the series of rapids in that vicinity the rock is in thicker masses, consequently the falls are in the midst of the rock exposures.

Above the mouth of the Matiteto a higher terrace is reached and through this an older valley, opening to the east in a wide mouth, is entered. The eastern face of this terrace and the sides of the old valley show sandy deposits which are probably the shore deposits when the sea flanked the eastern edge of this plateau. Their nature was not worked out, owing to lack of time, but there is little doubt that beaches may be found in this vicinity. Through the old valley the river is now cutting another channel, and

Landslides on outer bends of Ekwan River. Photo by D. B. Dowling

for ten miles upward the stream is very active and is wearing rapidly through the clay. Above this the grade is not so steep and consequently the current is much slower. The immediate banks of the stream in many places do not reach the sides of the old valley, but the higher plateau is in view at many points, and finally, before reaching the mouth of the Washagami, the river seems to be flowing in a much narrower valley with occasional cut-banks apparently the old channel slightly deepened. The active part of the revived stream has not yet reached the underlying rock, and its work is retarded by an occasional accumulation of boulders. About six miles below the Washagami a sudden bend of the stream to the south has thrown the current against the south bank, and excavation on a large scale is going on in this locality.

The high plateau here entered, as well as its eastern slope to James bay, is covered by a coating of marine clay which probably overlies boulder clay. That some of this exists beneath the marine clay is proved at only one or two small exposures. It probably, in many places, contains no boulders and therefore the dividing line between it and the marine clay is hard to define. The reddish clay near the mouth of this river, although mainly free from boulders, appears to have received its colouring mat-

ter from a soft red shale which, though not outcropping on the bank, may occur in the bed of the river below the limestone. This may be a local development of the boulder clay, as were it a part of the marine deposit a more extensive distribution might be expected. Large boulders are not numerous in the river channel, but at intervals there are accumulations of them. Small rounded boulders and pebbles are common, but the majority seem to come from the surface of the clay or the upper part of the section. Marine shells were collected from the banks near the top of the exposures, and these are of the same species as those recorded on a previous page as having been found near the mouth of the stream. The same species were also collected from the higher parts of the plateau at an elevation of four hundred feet above tide, showing that all this region was submerged at the close of the glacial period, to at least between four and five hundred feet. The uplift since then has been greater perhaps in the northern part of this area than in that to the south near the height-of-land. The differential uplift is clearly shown in the area to the west formerly covered by the glacial Lake Agassiz, where the highest beach at the north-east corner of the Duck mountains is now 350 feet above the outlet at Lake Traverse. The plain now drained by the Ekwan and Attawapiskat rivers, on its emergence from the sea, sloped northward, and the drainage probably took a northern direction to Hudson bay but, as the plateau reached an elevation approaching its present position, this slope was lessened and the streams were diverted toward James bay. The older portions of the river channel, which are situated in the higher part of the plateau, probably carried streams which found their outlet by uniting, and flowing to the north from the vicinity of the Little Ekwan river and thus through the deep valley in which is situated Sutton Mill lakes. The present general direction for both these streams is on nearly parallel lines running north-easterly, but making a decided bend to the east and east-south-east from the vicinity of the Little Ekwan.

The surface of the plane or slope toward James bay is very regular, and the uplift and consequent retreat of the sea very uniform in its movement. A slight steepness in the slope at the rapids at an elevation of 100 feet above the sea might be accounted for by a short halt of the sea margin at this line and consequent denudation. As the drainage on all this slope is new, the greater part of the surface is still very flat and swampy, as the minor drainage is not developed.

Washagami River

The canoe route from the Ekwan river to Sutton Mill lakes follows a small branch from the north to the first small lake and thence westward, by a series of portages, to a stream flowing north to the lake. This branch, called the Washagami, is a small stream, very swift in its upper part and having a steady strong current all the way down to the Ekwan. Five miles from this stream it receives a tributary from the west, called the Nematagoi river, which appears to be nearly as large as the north branch which is supposed to be the main stream. Above this the water of the stream is clearer and comes from a series of lakes above. Several tributary brooks enter the valley, but they are all apparently small. In the upper part, the stream meanders from side to side of a valley which it has formed. This is cut down about twenty-five feet and numerous exposures show stratified clay, with a few feet at the top of a sandy clay with pebbles. A few boulders in the bed of the river are apparently derived from the surface or upper part of the clay. Probably the majority are from the harder clay beneath, down to which the channel has been cut. Some of the steeper parts of the channel, where the current is also swift, are completely paved from side to side with these boulders, now considerably rounded. The valley in the lower part approaching the Ekwan is wider and the present channel of the river seldom reaches either side.

In the distance traversed to the first lake, seventeen miles in direct line, the fall is about fifty-five feet or an average of over two feet per mile for the lower third of this distance, and this is increased in the upper to at least five feet per mile for a short distance.

On reaching the first lake it is quite noticeable that there is no longer a river valley such as in the lower part, but the lakes occupy a wider depression that may have been an old channel. The first one is Washagami lake and it is succeeded by a chain of three closely connected small lakes to another large one called Minago or Spruce lake. The first mentioned is said to be the largest or rather longest of the group. Beyond Minago lake lie Moss and Tamarack lakes. On the north side of the latter, high hills of black rocks, which are probably similar to the trap rocks of Sutton Mill lakes, are reported.

This series of lakes appears to lie in a valley now draining south, but it seems too large or wide to have been formed by the small stream now draining through it. The present stream has no doubt formed a new channel to the south of the lakes, as it is still very actively widening the bends where it touches each side of its own

valley, but above this there is an older valley. The origin of this, as well as of the valley of Sutton Mill lakes, is no doubt connected with the early system of drainage, now probably diverted into other channels by the differential uplift of the coast.

The portage route from the Washagami to Sutton Mill lakes is mainly along the surface of the higher plateau through mossy muskeg interrupted by a few small lakes all draining eastward to the Little Ekwan river. Leaving the Washagami, the trail runs northward nearly a mile through muskeg, rising steadily to a gravel ridge having the appearance of a beach ridge. This is followed a mile to the north-east to the first small lake. On the north side of this ridge are several small lakes which all drain to the east from one to the other. At these lakes two short portages are made and then the second long portage is reached. This is about a mile and a quarter long through lumpy, mossy muskeg and only one slight rise is crossed where the ground is dry. It ends at a small lake about 500 yards long with low margin. From the north-east end of this, another long portage of about the same length running east north-east reaches the western edge of a deep valley running north to Sutton Mills lakes. This contains a small stream from the north-west which has cut a deep narrow gorge through the boulder clay. This stream enters the valley at Sutton Mill lakes about two miles south of the lake and meanders back and forth through a marsh at its border. The stream is navigable for canoes from the end of the trail, or for that part of its course which is in the deeper valley. Several small rapids over gravel bars are passed before the stream reaches the marsh. The Indians have erected a fishing weir at one of the upper ones. This structure is merely a close fence made of poles standing across the stream having a basket at one side also of poles sloping slightly up from the water to imprison the fish as they are going down stream. Small fish pass readily either way, but the larger ones are caught.

The timber in the valley is very much larger than on the surface of the plateau. Black spruce and tamarack are the principal trees, and on the plateau these average about four or five inches, but in the valley near the lake several about twelve inches in diameter were seen. The surface is nearly everywhere covered with moss, even on the slopes of the valley, and only in occasional places was grass seen.

Sutton Mill Lakes

These are represented on the older maps by two fairly large wide lakes joined by a short small stream, whereas the lakes are long and very narrow, occupying a deep valley running north and south. At the south end another valley from a short distance to the west makes a bend to the east and joins the main one. The water of the lake is about 100 feet below the level of the bordering country. The slopes of the valley are steep and in many places show cut-banks of marine clay, probably overlying boulder clay. Marine shells were collected near the upper surface of the plateau at a height of 90 feet above the lake, so that practically all this area has been submerged with the exception perhaps of a ridge of trap-covered rocks which cross the lake at the narrows. Those rocks protrude through the clay plain in rounded oval ridges.

The depth of the valley below the general surface seems to be greatest in the southern lake where, by sounding, the water was found to be 210 feet deep, or a total depth for the valley below the surface of 310 feet. In the northern part, or the northern lake, the width is much narrower, but the depth in the centre runs from 100 to 160 feet or 250 to 260 feet below the general surface. In the narrows the cliffs are broken down and the debris has filled the channel, raising the water in the southern lake about five feet. The heavy mantle of drift has effectually concealed the rock, and only in the river valleys and in such a cut as this is much rock to be seen. The limestone of the Ekwan river does not come north to the lakes, as outliers of the trap hills occur just to the south of the lake in the valley into which the trail from the Washagami leads. In the northern lake, past the trap hills, limestone again appears, and an exposure of it occurs on a small island where there is about ten feet exposed. Below the water-level the cliff is abrupt to a depth of sixty feet. This shows that probably the Silurian deposits surround the Cambrian, but are at a lower level. The valley, although excavated through the superficial deposits, found as its lowest level a former break not only through the Cambrian at the narrows but also a deep cleft in the limestone beds to the north. In the valley which runs northward from the lake, the limestone beds cross the present river channel at a greater elevation above the sea than the cut through them in the lake valley.

As to the origin of the valley in which the lake lies, it seems to be clearly caused by the action of a stream, which in some manner has since been diverted, probably to flow eastward to James bay.

If the rising of the land was inaugurated in the southern part and gradually proceeded north as the pressure of the glacial mass was removed, then the general slope northward would have been steeper in front of the elevated portion and drainage channels

would follow in this direction forming valleys trending north. After the elevation was accomplished or the land assumed its present contour, parts of these valleys would be so tilted as to back up the contained streams and cause them to spill down the present slight incline to the east. In this way it seems probable that such streams as the Ekwan and Attawapiskat, which make a decided turn to the east from a point south of this lake, might have originally run northward to Hudson bay. In the description of Ekwan river the difference in age of the upper and lower parts of the valley is noted and also the supposition that the stream left its present valley near the mouth of the Little Ekwan.

The great depth to which the basin is eroded may be due to other causes, and one suggested by the presence of faults at the narrows is that the changes of level to which the crust has been subjected caused a great fissure to open along the line of the lake valley and a portion of the overlying deposits was thus allowed to drop down. If, however, this was the chief cause, the break would probably be traced for a greater distance than the length of the present lake valley.

Sketch map of Sutton Mill Lakes.

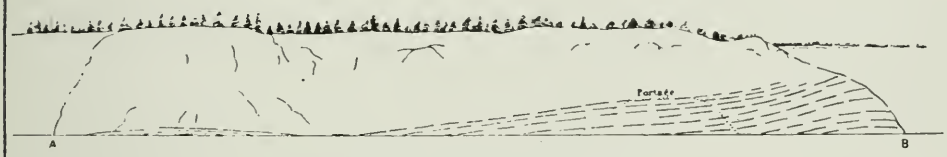
Trap, and Iron-Bearing Slates

The rock exposures occur principally at the narrows, or near the small stream connecting the two lakes. Approaching this from the south, the clay slopes give place to rocky hills rising from the water, in steep slopes and nearly bare surfaces, to about 100 feet above the lake level. Back from the lake some of the hills seem to attain still higher elevations, of probably over 200 feet. The accompanying sketch-map shows the trap-crowned hills of this vicinity. On the east side a series of fine-grained compact red and black beds is exposed; on the west the exposures are of trap to the water's edge. The fault, which runs north and south, here has a downthrow to the west of over 50 feet, carrying all the stratified lower rocks beneath the lake level. The only sections of these beds to be seen are on the east side, principally in the

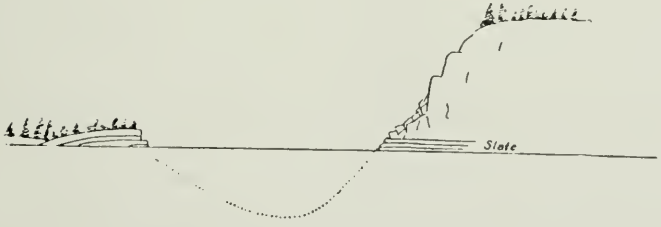
vicinity of the portage. Just at this place, a small cap of trap stands near the gorge, and behind it, to the east, is a narrow valley not eroded as deeply as the cut at the stream, but only to the upper beds of the sandstone and slate. Through this valley the road for the portage passes, rising to about fifty feet between its extremities.

The highest point that the trail reaches is over a ledge of iron-bearing slates, above which on either hand rise the rough hills of trap. As the slates are nearly horizontal, the total thickness exposed on the portage road, together with that brought up by a slight anticline just to the south, represents all that was seen of these rocks. Northward the beds decline at a slight angle, so that they reach the water and are brought up again for a short distance at the second narrows, or the point marked A

Cross section at B on sketch.



Section from A to B on sketch.



Cross section at A on sketch.

on the sketch. Here the fault runs to the west of the projecting point so that the same beds appear on both sides of the channel, but the western point is separated from the rocks to the westward by an accumulation of drift material forming a low spit with sandy bays on either side. The deep channel is eroded through the sandstones, to a depth of 140 feet. The section published in the summary report is that of the rocks to the south of the portage road. The jaspilytes when examined in thin section are found to be compacted sandstones, the grains of which are stained to various shades of red by the presence of iron oxide, which forms in many cases a coating around them. All the beds are made up of fragments of various degrees of fineness arranged in a natural order, the coarser at the base and the finer at the top. The slaty beds just

beneath the trap are made up of much finer grained particles of quartz, coloured dark by a matrix of opaque fine-grained material separating the grains. Some at least of this mass is probably magnetite. The quartz grains constitute 50 per cent. of the mass, and of this about half are of red chalcedonic quartz and the other part clear grains made up of a mass of mosaic quartz. The red beds beneath are of much coarser grain, and are seen, even in a hand specimen, to be made up of rounded particles of red colours.

At point A the dark slates have a thickness of 20 feet, and below this the red beds begin to appear in thin streaks. The partings of the fine-grained dark slates become thinner and the lower beds become red in colour.

At the portage the section consists of ninety feet of stratified beds capped by a varying thickness of trap. On the west side of the stream there is a thickness of about 150 feet. This is a dark green gabbro with a diabase structure. The predominating mineral is chlorite, with plagioclase, albite and quartz. Small dark almost opaque crystals of ilmenite surrounded by limestone are occasionally seen. The slates beneath, to a thickness of 20 feet, are dark grayish black to greenish black and are thin-bedded and of fine grain.

Near the base they resemble clay slates but are very hard and brittle, being cemented by the magnetite. An analysis of a specimen from this bed, furnished by Dr. Hoffmann, gives metallic iron 33.40 per cent, siliceous insoluble residue 48.49 per cent. The percentage of quartz increases downward in the section, and thin layers found at eighteen feet from the top are nearly all quartz. Some of the red beds near the top are somewhat crystalline in appearance, but on a polished surface the rounded grains are quite apparent. At 27 feet below the top, the rock consists of a bright red, close grained jaspilyte, which in thin section shows well rounded grains of a bright red material, in all probability an eruptive, which was broken to a sand and cemented by quartz forming hard quartzite. The cementing quartz is in a fine mosaic and some of the red grains show minute cracks and sometimes a net-work of fissures which are filled by the same mosaic. In a few of the grains that have less of the colouring matter, the material is a reddish chalcedonic quartz with a dark red staining around the margin. At about 30 feet down in the section, the red sandstones alternate with dark rusty-weathering coarse slates. At 35 feet, the dark semi-crystalline beds are composed mainly of small particles of quartz and magnetite. The percentage of magnetite, as determined by Dr. Hoffmann, is very high—the metallic iron content being 68.62, the insoluble residue 4.21 with no trace of titanic acid. This would make a very good ore but it appears to be in very thin beds alternating with the sandstones. As all these ores have a very high percentage of silica, owing to the bands of sandstone, but a reduction of this constituent might be had by selection or some mechanical process. From many of the beds between 40 and 50 feet in the section, thin members are found to be nearly pure magnetite, while the thicker beds are of the dark red sandstone containing less of the iron ore. A talus covers the section from 50 to 70 feet. Dark hard beds with narrow partings of slates similar to the top beds are found down to 80 feet. The lowest beds, or down to 90 feet, are very dark red sandstones of the same character as those above, but the outside of the grains and in many cases the whole individual is composed of the iron ore. An analysis of a specimen from the lowest bed exposed shows less iron than in the slates at the top; besides the lower members of this section are very hard. This rock contained metallic iron 27.72 per cent. and insoluble siliceous residue 61.12 per cent. These samples are not specially rich in iron, but serve to show that the whole mass of this hill contains a large amount of low grade ore. The three samples analyzed are from the top, middle and bottom of the section.

On the small island in the northern lake a cliff of limestone was found. The beds exposed are somewhat similar to those seen on the Ekwan at the upper rapids. In this cliff there seems to be a great mass of broken fragments of corals and shells, mixed with what appears to be limestone fragments, the whole forming an agglomerate. The colour is an ashy gray. Beneath the water the beds are yellowish and of a finer grain. A few badly preserved fossils were collected, but among these Dr. Whiteaves has recognized or described the following species: *Zaphrentis Stokesii; Favosites Hisingeri; Phœnopora Keewatinensis; Stropheodonta* sp. indet.; *Calymene Niagarensis* (?); *Encrinurus* sp. indet. Limestone fragments are numerous along the shores to the south of this, to within four miles of the narrows, and are derived no doubt from the beds beneath the water.

In the southern Sutton Mill lake limestone pebbles are also numerous, but they are mixed with fragments of other rocks and are derived from the boulder-clay of the banks, while marine shells from the upper marine clay are also mixed with them. The timber seen along this lake is mostly spruce and tamarack. The heaviest growth is in the valley at the southern end of the lake, and along the small streams draining into it from the west. In going up the lake, the timber gradually becomes smaller, though

at the portage between the two lakes there is a fair grove of spruce, and a few poplars form a fringe along the southern slope and on the lower ground south of the narrows. In the northern part there is one grove of poplar on the western ridge, four miles north of the narrows, growing on a ridge which seems to be made up of limestone fragments and therefore well drained. This grove is quite parklike, it being carpeted by grass instead of the almost universal moss which seems to cover the whole country. The spruce is mainly the black species (*Picea nigra*) and scarcely any trees of the white spruce are seen. Of the poplar, both species are found on the Ekwan, but on the lake *Populus tremuloides* seems to range farthest north. Near the north end of the lake the spruce trees become not only small, but are separated from one another by mossy openings, as if they had been set out artificially. Along the top of the bank the fringe of trees is thin, and at the outlet, Trout river, a patch of burnt country will in a few years be bare.

The country seems to be nearly devoid of game, but the waters of the lake are well stocked with a slender kind of lake trout, and in the stream draining north and at the narrows brook trout were found in large numbers up to three pounds in weight Along the shores marine shells from the clays of the sides of the valley are found along with those of fresh water species now existing. These latter embrace the following:—*Valvata tricarinata*, Say; *V. sincera*, Say; *Planorbis parvus*, Say; *Limnæa stagnalis*, *L.*; *L. palustris*, *Müller;* and *L. catascopium*, Say; as determined by Dr. Whiteaves.

Coast of James Bay from Ekwan River Northward

In the bay into which the river empties there are many bars, but the main channel leads straight out to sea for a short distance and is then diverted north and south by a long bar which shoals at half tide. This bar is about three miles from low tide mark. There are two or three branch channels just at the mouth, through the gravel and mud delta, but these are used only when the tide is in. Along the shore to the point about five miles north of the river the general slope of the shore is fairly steep, that is, the mud flats do not extend out very far. The resident Indians call this point "Niahkow" (the sandy point), but it seems to be made up principally of mud and boulders, with a sandy beach ridge at high tide. The boulder bar stretches out far to the east at low water. We saw it only at half tide and then had to make a long detour around it with the canoes. Several small brooks break through the ridge to the bay, and tent poles at these places indicate their occasional use as halting places or camps.

The timber line is here near the shore, but runs at some distance back of the point from Niahkow northward; for about ten miles the shore is fairly straight but shallow, with few boulders on the mud flats. The beach ridge is separated from the timbered land behind by a narrow strip of mud, which in some places is covered by grass and a few small willows. A high gravel bar lying about a mile off shore marks the mouth of a small stream, which is an outflow from the Ekwan river. The stream is small and flows in a shallow sheet over the mud flats, so that it cannot be entered even by canoes except at high tide. Here the higher beach ridge is near the timber line and a mud flat extends out 200 yards to a second gravel ridge which has been formed in front by the high tides. A lower ridge is now being formed in advance of this again, but it is covered by the highest tide. When the tide is out, it dries or uncovers to beyond the high gravel bar opposite, or to the north of the mouth of the river. The evening we arrived at this place, the Indians who were camped there pointed out to us a white object on the bar, and by examination with the glass it proved to be a wandering white bear which had come ashore on a piece of ice. Our friends were rather nervous over the matter, but the animal had disappeared by morning, and the only other traces of this species were some tracks that were seen along the shore farther to the north.

Northward from this brook there is a slight bend in the coast to the west to form a shallow bay and at about ten miles from the brook a fair sized stream called locally Wabishew Sipi (Swan river) enters the bay. The shore of this bay is flanked in many places by sand ridges, but as we passed at low tide we saw only part of the shore, and the mouth of the river being at a distance was hard to make out. As the shore here is backed by a uniform line of small spruce trees, varied occasionally by higher bunches or groups, a grove of poplar which shows on the left bank of the stream when opposite, is about the only indication of the presence here of a river. Northward from this stream the shore bends slightly to the east again, and a point sixteen miles north of the river is in the same longitude as the mouth of the brook which comes from the Ekwan river. At eight miles from Raft river, gravel bars that form small islands at half tide run out from the shore to the southeast, and behind these the shore ridge for a short distance is wanting, and the mud slopes up gradually to a grassy flat. The tree line of small spruce follows the shore pretty closely for about fifteen miles north, but it then leaves the beach and turns to the north-west.

The points are merely high gravel ridges, which are formed parallel to the shore in an irregular order. The intervals between are connected by lower ridges forming loops. Another series is also found in a few places near the tree-line belonging to an earlier set. Small streams are found running out by the gaps in the shore ridges and afford camping places between the mouths of the larger streams. At thirty miles north of the Raft river two high sand bars or small islands are again seen near the shore.

They are situated inside the tide-line and at low tide are not reached by the sea. Opposite, on the mainland, a narrow fringe of trees forms a point behind which the tree-line bears off toward the northwest. This may be the "Point Mourning" referred to by Capt. Coats, as being so named from the burying of one of Capt. James' men there. James' account does not mention this occurrence, and he appears to have landed on this coast only at Cape Henrietta Maria.

Extensive Mud Flats

Sailing along in a canoe, the shore-line seems very far away, but gulls, yellow-legs and other small birds were perched along on the edge of the mud and were the principal guide to the direction of the shore-line, as the mud flats look like smooth water, since there is always so much water draining down the slope.

Several large boulders appear at low tide at this point, and there are also two high gravel bars opposite the end of the trees. From Point Mourning northward, the shore turns about north-west as far as the Opinnagow river, and the beaches seen at high tide disappear and the slope of the shore becomes much flatter. Long shallow ridges of clay run out to the north-east, just after passing Point Mourning, and on these are scattered many boulders. The larger ones are frequently near the shore, but they do not seem to indicate having been shoved in any direction by the ice, as is so often shown on the shores of such shallow lakes as Lake Winnipegosis. The shore slopes upward very gradually, and is of mud to the highest point.

At the margin of the ordinary tides a thick wiry grass covers the surface, and is succeeded by a small scrubby willow which extends back to the timbered country. Several brooks and small rivers enter the bay just to the north-west of Point Mourning. A stream called Nowashe river, at eight miles from the point, cuts a wide but shallow channel through the mud, but it is not deep enough to enter except at high tide and is probably an overflow channel from the Patchipawapoko, the next stream which comes in at about eleven miles from the point. The mouth at low tide is wide but very shallow and dotted with boulders. The sand bars which have formed the beach end before reaching this stream, and are succeeded by mud shores. These extend along for six miles between the last stream and the Opinnagow river, which is the largest along this part of the coast. The channel leading to this river is deeper at low tide than any of the others. Instead of a broad shallow bar at the mouth, the river is divided into two channels by a grassy island near the sea. That to the south is probably the larger, but is impeded by boulders. At low tide there is a shallow part near the line of high tide where the greatest accumulation of the boulders is found, but below this and out to low tide the boulders are less frequent. At low tide the entrance to this channel is two or three feet deep, so that a small boat could get in and come up the river as the tide deepened the channel. The main difficulty would be in finding the river at all, as there is so little to mark its position—the tree line being so far from the shore.

Along this part of the coast there are no bars visible at any distance from the land, as is the case along that part near the mouth of the Ekwan.

Although the coast is very flat the navigation for small boats does not offer any great difficulties except from the want of harbours. Our guide thought that a small sail-boat could be taken into the mouths of Raft and Opinnagow rivers, and that as the shore was fairly free from boulders, the boat could if necessary be run ashore without damage at high tide and left in the mud.

The great objection to this method of finding harbour is in the fact that the tide does not maintain an even flow or ebb, being influenced to a very large extent by the direction and force of the wind. The ordinary flow of the tide may be assumed to be about six feet, but a heavy north wind may raise it to over twelve and a south wind will lessen the flow, though not to such a large amount.

Geology

The formations observed in the district consist of (1) the Cambrian rocks of Sutton Mill lakes; (2) the Silurian limestone bordering the west shore of James bay and the south shore of Hudson bay; and (3) the clays which form the general covering over nearly all the country left by the ancient glacier and the retreating ocean.

Cambrian

The rocks which are probably of this age are closely allied to those previously described by Dr. R. Bell and afterwards by Mr. A. P. Low on the east coast of Hudson bay and in the narrow belt of islands parallel to that shore—the Manitounuck, Nastapoka

and Hopewell islands—and the narrow strip along the coast in the neighbourhood of Manitounuck sound and at Richmond gulf. These were described by Dr. Bell in the report for 1877-78, pp. 11-19, and called the "Manitounuck Group," and their similarity to the rocks of the Lake Nipigon region was pointed out.

The section there recorded, is in a general way, made up of quartz conglomerates, quartzites and sandstones. Associated with and over-lying them is a series of cherts and shales, mostly dark coloured. Over-lying these beds is a heavy trap overflow and the total thickness of the series is placed at about 2,800 feet. This great thickness is not found on the west side of the bay, however, but the upper part is probably there represented. The lower part is no doubt concealed by the Silurian limestones which are deposited along the margin, flanking it, not only on the Hudson bay side, but also to the south in the valley of the Ekwan river. The thickness of the marine clays and till which surround this rocky ridge, also conceals the underlying rock, and it is only in such an erosion valley as that of the lake above referred to, that exposures of the beds beneath the trap can be seen.

In the vicinity of Sutton Mill lakes the series is nearly horizontal, inclining slightly to the north toward the basin of Hudson bay and as exposed consists of a thickness of

Narrows, Sutton Mill Lakes. Photo by D. B. Dowling

90 feet of sandstone and slates, capped by an extrusive trap showing a thickness of 150 feet. The sandstones and slates here, as well as on the Labrador peninsula, are impregnated with iron oxides chiefly in the form of magnetite and hematite. The sandstones exposed are composed of rounded and flattened grains of a reddish chalcedonic quartz surrounded by a slight deposit of the iron ore, and the interspaces are filled by a fine mosaic of quartz. In the darker coloured rock the grains are surrounded, and in parts replaced, by magnetite, while the interstitial quartz is less in amount. The appearance of the beds is that of a banded jasper, consisting of red beds separated by numerous narrow seams of a dark slate. On smooth surfaces the individual grains of the sandstone are distinctly shown. The slates which occupy the upper part of the section are made up of minute fragments of quartz, both red and colourless, forming 50 per cent of the mass, while the remainder is made up of a series of opaque particles which, from the result of an analysis of the rock, is probably largely magnetite.

These rocks, when compared with those from the Animikie of Thunder bay, present many features in common. Their description as given by Mr. E. D. Ingall (Annual Re-

port, Geo. Surv. Can., vol. III., p. 81 H.) shows that the general character is very much the same, but in the Sutton Mill lakes rocks the calcareous and dolomitic portions are wanting or have been replaced. The only mineral of economic importance observed in this series is iron. Magnetic ores of this metal are freely distributed throughout the whole of the section of the stratified series, but the fact that these ores are not generally concentrated in thick enough beds would count against their practical value. Closer examination might show that the richer parts of the section could be profitably worked. A few specimens from the exposure were brought in to the laboratory, and analyses of three were made. These are from the upper part of the section, the centre, and the lowest bed. The analyses of the three samples, as furnished by Dr. G. C. Hoffmann, are given below:—

From the upper bed—	
Metallic iron	33.40 per cent.
Insoluble siliceous residue	48.49 "
Titanic acid	none.
From centre of the section—	
Metallic iron	68.62 per cent.
Insoluble siliceous residue	4.21 "
Titanic acid	none.
From lowest bed exposed—	
Metallic iron	27.72 per cent.
Insoluble siliceous residue	61.12 "
Titanic acid	none.

The upper and lower beds represent the general mass of the sandstone and slate, the first being the slate of the beds just below the trap and not picked out as being an iron ore, while the specimen from the base of the section was of the dark red sandstone or jaspilyte, which showed streaks in which the magnetite made up a large percentage. The specimen from the centre of the section represents one of many of the richer beds in which nearly all the silica has been replaced by magnetite. There is a probability that thick enough beds of this ore could be found for profitable working, but their remoteness from the sea or any line of railway would render their present value in any case very doubtful.

Silurian

The valleys of all the streams entering the western side of James bay are cut down through the drift deposits to a flat-lying limestone, which forms a wide belt around the west shore of the bay and along the southern shore of Hudson bay. On the Albany river the upper part of the series is proved to be of Devonian age, and beneath, at a greater distance from the sea, Silurian limestones are exposed. These beds probably overlap any older ones that may be beneath, and rest directly on the Archæan.

On the Attawapiskat river Dr. Bell recognized the Silurian in the upper reaches of that stream, but a small series of fossils collected farther down, near the bay, seemed to present a Devonian facies, and the rocks of this age were then supposed to extend northward to this river. The collection of fossils from the portage on the Ekwan river was as complete as we could make it in view of this fact. Many of the species formerly collected both from the Attawapiskat and the Severn rivers were of forms apparently new to science or undescribed, so that their value as horizon markers was not very great. My collection embraced many more species and some in a good state of preservation, so that Dr. Whiteaves had no difficulty in deciding at once that they were not Devonian but Silurian and that the species brought from the Attawapiskat river were in a great measure duplicated in this collection.

It seems therefore certain that the Devonian rocks are confined to the southern part of James bay and the adjacent country, extending a short distance north of the Albany river. On the Severn river Mr. Low collected fossils which appear to be of Silurian age.

The section of the Ekwan appears to be nearly horizontal, or the beds exposed in ascending the stream seem to be in an ascending series. The first appearance of the underlying rocks noted in ascending the stream is a colouration in the boulder clay, probably from a red shale in the bed of the river. Exposures of this were not seen, but higher up at the first heavy rapid, limestone of a gray to whitish colour in lumpy beds outcrops both below and at the rapid. The beds are very hard and dolomitic and contain very few fossils. At the next rapid the beds are yellowish and appear in thinner layers and of finer grain. The thickness exposed at both these rapids does not appear to be of any great amount, probably not over 20 feet.

The exposure at the portage is of a very irregularly bedded limestone, owing to the presence of large masses of porous or coralline formation, which has formed a very

irregular surface for the succeeding layer which in consequence seems contorted. Below the coralline mass the beds are thin and of fine texture. The general colour is a grayish white and the rock is hard, tough and massive, and contains a greater variety of fossils than any of the other exposures. Lists of the species found at these several rapids are given in the general descriptions for the localities. All the exposures at the rapids above this have a very similar appearance, except that in the exposures near the last rapid of this series the lower beds are fragmental, or break with a lumpy surface and are ash gray in colour. Above these are yellow beds, in which there are numerous irregular cavities. The ashy coloured beds bear a very strong resemblance to the Devonian rocks of the south shore of Lake Winnipegosis, but do not hold different fossils from those at the portage on this river. The yellow beds which are full of cavities are similar to rocks of Silurian age on Cedar lake in the Saskatchewan district.

Other exposures of these beds occur to the north of the Cambrian rocks of Sutton Mill lakes, and are found very near them so that the continuity of the series around this mass both by the south to the Severn river and to the east by the coast is almost certain. On the extreme end of the eastern point at Cape Henrietta Maria, our Indian guide described exposures of what seemed undoubtedly to be limestone of about the same characteristics as that on the Ekwan river.

Post Tertiary

On all the rock exposures in the country adjacent to the Ekwan river, where the exposed surfaces have not been subjected to denuding agencies, glacial striæ have been recorded showing a movement of the ice mass toward the south-west. Only one exposure on the Ekwan showed such a striated surface, and this gave S. 40° W. All or nearly all the surfaces exposed in the valley were eroded by river action and the scouring effect of ice in the spring floods, so that the original glacial striæ were obliterated. The till left by this ancient glacier is deposited in an even mantle over the surface and contains a few boulders, but the fragmental portions of the mass are of small size. The depression of the earth's surface, owing to the weight of the ice sheet, is shown by the presence of marine clays on the surface of the boulder clay, and as these are of nearly the same composition as the clays beneath, the line of demarcation is hard to define. The marine clays extend up the Ekwan river to past the mouth of the Washagami and northward to and surrounding the ridge of trap which protrudes through the plain at Sutton Mill lakes. The extreme limit of submergence in the district to the south is given by Dr. Bell as 500 feet. Near Sutton Mill lakes the top of the marine terrace now stands at 400 feet above tide, so that the submergence of the present coast line was greater than this amount. The fossils which determine these clays include the following species: *Saxicava rugosa*, *Mya truncata*, *Macoma calcarea* and *Cardium ciliatum*.

APPENDIX I

Preliminary list of fossils from the Silurian (Upper Silurian) rocks of the Ekwan river, and Sutton Mill lakes, Keewatin, collected by D. B. Dowling in 1901, with descriptions of such species as appear to be new.

By J. F. Whiteaves

Anthozoa[36]

Tetracoralla

Zaphrentis Stokesii, Edwards and Haime.

Ekwan river: portage road at falls, two specimens; and upper rapid, two specimens. Small island in the northern of the two Sutton Mill lakes: four specimens.

Pycnostylus Guelphensis, Whiteaves.

Ekwan river: portage road at falls, one specimen; and foot of portage road, one specimen.

Pycnostylus elegans, Whiteaves.

Ekwan river, portage road at falls: one specimen.

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[36] The Anthozoa have kindly been determined by Mr. L. M. Lambe.

Hexacoralla

Favosites Gothlandica, Lamarck.

Ekwan river: foot of portage road, five specimens; portage road at falls, one specimen; and upper rapid, one specimen.

Favosites Hisingeri, Edwards and Haime.

Ekwan river: lower rapid, one specimen; foot of portage road, one specimen; and portage road at falls, one specimen.

Small island in the northern Sutton Mill lake; one specimen.

This species occurs also in the Niagara and Guelph formations of southern Ontario.

Octocoralla

Halysites catenularia, L.

"The typical form, as identified by Canadian and United States palæontologists, under this name or that of *Catenipora escharoides*, Lamarck, and *C. agglomerata*, Hall." Lambe.

Ekwan river, foot of portage road: one specimen, that, according to Mr. Lambe, is like specimens from the Niagara and Guelph formations of Ontario and from Division 4 of the Anticosti group of Anticosti. *Lyellia superba*. (=*Trematopora superba*, Billings.)

Ekwan river, portage road at falls: one specimen.

Hydrozoa

Stromatoporoidea, genera and species undetermined.

Ekwan river, portage road at falls: two fragments, which seem to be referable to different genera.

Echinodermata

Crinoidea, genera and species uncertain.

Ekwan river, portage road at falls: a cast of the interior of a dorsal cup, that shows little more than the general shape and the impress of a few large hexagonal plates. Foot of portage road: two portions of finely annulated columns, which are circular in section and perforated by a pentalobate axial canal.

Polyzoa

Fenestella subartica, sp. nov.[37]

Zoarium spreading, somewhat fan-shaped, but probably funnel shaped when perfect. Branches very slender, carinated on the celluliferous face, and averaging from a fourth to a third of a millimetre in thickness. Bifurcations very infrequent in the only specimen collected, occurring at intervals of five mm. or more. Interstices much wider than the branches. Dissepiments about one mm. apart, or four and a half to five in the space of five mm. Fenestrules longer than wide, irregular but somewhat rectangular, nearly or quite a mm. long and approximately about half as wide as long. Zoœcial apertures circular, in two ranges, opening somewhat laterally, twenty in each range in the space of five mm., and three or four on each side in the length of a fenestrule, closely disposed but separate, slightly irregular in their disposition, sometimes alternate on the two sides of the keel, sometimes opposite, their margins indenting the borders of the fenestrules. Under a highly magnifying simple lens, the keel appears to be minutely spinose in places.

Ekwan river, portage road at falls: one fairly good specimen. Mr. R. S. Bassler, of the U. S. National Museum, to whom the writer is indebted for critical suggestions in regard to the structural peculiarities, and affinities of this and the following species, writes that the zoœcial apertures of this *Fenestrella* "seem unusually large, but this is due to the removal of the outer investment of the zoarium."

Phœnopora Keewatinensis, sp. nov.

Zoarium bifoliate, branching, consisting of a thin flattened frond which is six millimetres wide on an average, but ten mm. wide at a bifurcation, and which bifurcates at intervals of about eleven mm. Zoœcia rhombic, a little longer than wide, seven in two millimetres measuring lengthwise and eight to eight and a half measuring transversely, divided by thin, straight longitudinal partitions, which form their sides and separate them into longitudinal rows. Apertures of the zoœcia obliquely ovel. Surface marked by arching striæ, which curve convexly forward.

[37] It is hoped that the new species described in this appendix will soon be illustrated in one of the palæontological publications of the Survey.

Small island in the northern Sutton Mill lake, one specimen. In regard to this specimen, Mr. Bassler writes as follows: It is "a *Phœnopora* closely allied to several Clinton species, but which I should regard as new. In zoœcial structure it is very close to *P. multifida*, Hall, and especially to *P. fimbriata*, James. *P. multifida* has a different zoœcial growth and slightly larger zoœcia. *P. fimbriata* has about the same zoœcial measurements, but the growth of the zoarium is quite different."

Seven other species of *Phœnopora* are known to occur in the Cambro-Silurian and Silurian rocks of Canada. These are: *P. incipiens*, Ulrich, from the Trenton limestone of Montreal; *P. constellata*, *P. ensiformis* and *P explanata*, Hall, also *P. punctata*, Nicholson and Hinde, from the Clinton and Niagara formations of Ontario; and *P. excellens* (*Ptilodictya excellens*, Billings), and *P. superba* (*Ptilodictya superba*, Billings), from the Anticosti group of that island.

Brachiopoda

Trimerella Ekwanensis, nom. emend.

Trimerella Equancnsis, Whiteaves. 1902. Ottawa Naturalist, vol. xvi, p. 141, pl. II, figs. 1 & 2, pl. III, fig. 1.

Ekwan river, portage at falls: three ventrals and two imperfect dorsal valves.

The specific name is here slightly amended, in accordance with the more modern spelling of the name of the river.

Trimerella borealis.

Trimerella borealis, Whiteaves. 1902. Ottawa Naturalist, vol. xvi, p. 142, pl. III. figs. 2 & 3.

Ekwan river, lower rapid: a cast of the interior of both valves.

Stropheodonta, sp. indet.

Ekwan river, foot of portage road: one well preserved ventral valve, with the surface markings essentially like those of *S. varistriata*, var. *arata*.

Stropheodonta, sp. indet.

Small island in the northern Sutton Mill lake: two specimens, with the exterior marked by very fine, equal, radiating striæ.

Plectambonites transversalis (Wahlenberg).

Ekwan river, foot of portage road: two imperfect but characteristic ventral valves. In the Museum of the Survey there are specimens of this species from the Niagara group at Grimsby, Dundas, and Hamilton; from divisions 2, 3 and 4 of the Anticosti group, four miles west of the Jupiter river, at Eastpoint, and at the Jumpers, Anticosti; also from the Silurian (upper Silurian) rocks of Lake Temiscouata, N.B.

Orthis, sp. indet.

Ekwan river, upper rapid: one half of the ventral valve of a small, rather coarsely ribbed and apparently undescribed species of *O. Davidsoni* type. A similar but more perfect valve, in the Museum of the Survey, was collected on the Fawn river, or branch of the Severn, by Mr. A. P. Low in 1886.

Camarotœchia Ekwanensis, sp. nov.

Shell small, moderately convex, transversely subelliptical and wider than long.

Ventral valve with an extremely small, narrow, erect or straight beak, behind, and a well defined mesial sinus, that extends backward to about the midlength, in front; the whole surface of the valve marked with thirteen rather distinct angular radiating ribs, three in the mesial sinus and five on each side.

Dorsal valve with a still smaller beak, and with a fold corresponding to the mesial sinus of the ventral, its surface marked with twelve angular ribs, four on the fold and four on each side of it.

Hinge area and interior of the valves unknown.

Ekwan river, portage road at falls; one well preserved cast of the interior of the closed valves.

This small rhynchonelloid may possibly prove to be an extreme variety of *C. neglecta* (the *Atrypa neglecta*, Hall, of the second volume of the Palæontology of the State of New York), from which it seems to differ chiefly in its transversely and rather narrowly subelliptical marginal outline.

Atrypa reticularis, L.

Ekwan river, foot of portage road: two small specimens.

Glassia variabilis, sp. nov.

Shell very small, strongly compressed and lenticular in outline in transverse section, or moderately convex and varying in marginal outline from nearly circular and sometimes a little wider than long to subovate and a little longer than wide.

Ventral valve with the front margin either nearly straight and devoid of sinus, or faintly sinuated, or provided with a rather wide but not distinctly defined, shallowly concave or not very deep, mesial sinus, that extends backward to about the midlength. Umbo of the ventral valve small, narrow and not very prominent or produced, its beak slightly incurved and apparently perforate.

Dorsal valve with the umbo and beak smaller than those of the ventral.

Surface apparently smooth.

Spiralia directed toward the dorsal side (Schuchert); jugum, muscular impressions, and hinge dentition unknown.

Dimensions of a typical and average specimen (from the Winisk river): maximum length, slightly over eight millimetres; greatest width, eight mm. and a half; maximum thickness, four mm.

Two small loose blocks of limestone from or near the mouth of the Winisk river, collected by Mr. W. McInnes in 1903, are almost exclusively composed of nearly perfect shells of this species, many of which have the spiralia, or internal spiral cones, preserved. Some of the best of these specimens have been examined by Mr. Charles Schuchert, of the U. S. National Museum, who writes as follows in regard to them in a letter dated March 9, 1904: "The spiral cones in the Winisk shell are directed toward the dorsal side, but I cannot see the jugum. For the present I would refer it to *Glassia*. In external characters it is very near to *G. subovata* (Sowerby), but the difference in the spiralia will distinguish them, as the latter has the cones inwardly or medially directed. This difference is certainly of specific value, but for the present I should not regard it as of generic importance, as different genera of the Atrypidæ have the spiralia directed either laterally, medially or dorsally."

Ekwan river, foot of portage road, one specimen; Fawn river (or branch of the Severn), thirteen specimens; all of which are probably referable to this species, though none of them show any vestige of the spiralia or of any of the other character of the interior of the valves. They are, perhaps, a little more convex proportionately than the typical form from the Winisk river. The sinus in each of their ventral valves seems to be a little more developed. In these respects the specimens from the Winisk are more like the *Atrypa compressa* of Sowerby, and those from the Ekwan and Fawn rivers more like the *A. subovata* of the same author, both of which are now regarded as forms of *Glassia subovata*.

Spirifer crispus? Hisinger. Var.

Ekwan river, middle rapid: one good specimen of a small radiately ribbed *Spirifer*, that is apparently similar, in size and general shape, to the *S. crispus*. as described and figured by European and American palæontologists, but which has narrow and angular, not wide and rounded, ribs.

Spirifer (?) sp. indet.

Ekwan river: portage road at falls, one specimen; and at foot of portage road, one specimen; both casts of the interior of ventral valves that are possibly referable to *S. radiatus*, Sowerby, but that are much too imperfect and too badly preserved to be satisfactorily determined even generically.

Reticularia septentrionalis, sp. nov.

Shell strongly biconvex, but often with a faint, shallow, narrow longitudinal groove or depression in the median line of each valve; varying in outline in different specimens from subovate or somewhat pentagonal and a little longer than wide, to not far from circular and as wide as long, but always abruptly contracted and attenuate in the umbonal region behind; front margin of the valves straight and entirely devoid of a mesial fold or sinus.

Ventral valve with a narrow but prominent or produced umbo, a depressed, incurved and acute beak, and an extremely small delthyrium.

Umbo and beak of the dorsal smaller and less prominent.

Most of the specimens are little more than mere casts of the interior of the closed valves. Their surface is entirely devoid of ribs of any kind, and at first sight would seem to be marked only with concentric lines of growth. But, upon closer examination, numerous, obscure, close-set and very slightly raised concentric lines, or faint and minute, low, rounded ridges, can be detected on portions of the exfoliated test that happen to be preserved, and the shell structure, under a lens, is seen to be fibrous.

Characters of the interior of the valves unknown, though there are indications of a medium septum in each.

Ekwan river: lower rapids, one specimen; middle rapid, one specimen; and portage road at falls, four specimens.

This large and nearly smooth species is provisionally referred to the genus *Reticularia* on account of its general resemblance to *R. modesta* (Hall), and *R. perplexa* (McChesney), which is the *Spirifer lineatus* of Shumard and other American palæontologists, but not of Martin; though it may prove to be a *Martinia*.

Reticularia (*?*) sp. indet.

Ekwan river, foot of portage road: two specimens, each of which has the whole of the dorsal valve and most of the ventral preserved, though the umbo and beak of the latter are broken off. Both are transversely subelliptical in outline and wider than long, and both have a rather shallow marginal sinus in the ventral valve. They are entirely ribless, but the better preserved one of the two is finely and nodosely cancellated by numerous, close-set, minute concentric ridges, that are crossed by similar radiating ones.

At the portage road at the falls a specimen, with the same general shape and with a similar sinus in the ventral valve, was collected, but it is so much worn that its surface markings are quite obliterated, and the beak of the ventral is so imperfect that it is impossible to tell whether it was originally perforate or not. This specimen seems to correspond fairly well with E. Billings' figures of *Athyris Blancha*, from the Silurian rocks of Maine, which Hall and Clarke refer to *Meristina*, but which Schuchert says is a *Meristella*.

Meristina (*?*) *expansa*, sp. nov.

Shell tumid, regularly and rather strongly biconvex, transversely subelliptical and always a little wider than long; front margin of the valves not at all sinuated; surface entirely devoid of any kind of ribs.

Ventral valve with a rather depressed though slightly prominent umbo, and an incurved beak.

Dorsal valve with a much more depressed umbo and a smaller beak.

Surface markings of the exterior of the test unknown, those of its exfoliated inner layer consisting of numerous, close-set and very minute, concentric raised lines, as well as of a few rather distinct concentric lines of growth; structure of the test fibrous.

Characters of the interior of the valves unknown, though there is clearly a long mesial septum in the ventral valve, and apparently a similar one in the dorsal.

Ekwan river: portage road at falls, one specimen; and foot of portage road, an unusually large but imperfect specimen. Attawapiskat river, seventeen to thirty miles below Rainy island, Dr. R. Bell, 1886: eight specimens.

These specimens are mere casts of the interior of the closed valves, with small portions of the inner layer of the test attached to some of them. It is by no means clear whether the beak of the ventral valve of any of them is perforate or not. They are provisionally and very doubtfully referred to *Meristina*, on account of their general resemblance in external form to the European *M. tumida*, but it may be that they should rather be referred to *Meristella* or *Reticularia*. They seem to differ from *Reticularia septentrionalis* in their uniformly, transversely and broadly subelliptical contour, and in the more depressed umbo of the ventral valve of each.

Mollusca

Pelecypoda

Ambonychia undulata (Whitfield).

Leptodomus undulatus, Whitfield, 1878. Ann. Rep. Geol. Surv. Wiscons. for 1877, p. 81; and (1880) Geol. Wiscons., vol. iv, p. 293, pl. xviii, figs. 1 and 2.

Ekwan river: portage road at falls, an imperfect left valve; and foot of portage road, a nearly perfect and very convex right valve.

Both of these specimens are marked with "strong regularly rounded concentric undulations." Mr. E. O. Ulrich, who has kindly examined the five specimens of pelecypoda collected by Mr. Dowling, and to whom the writer is indebted for some critical suggestions in regard to them, thinks that *Leptodomus undulatus* is an *Ambonychia* allied to *A. planistriata*, Hall, and that the former had fine surface radii.

Ambonychia septentrionalis, sp. nov.

Shell obliquely and acuminately subovate or subrhomboidal, very inequilateral, rather strongly convex, most prominent in the umbonal region of each valve. Anterior side very short, abruptly truncated, or rather inflected, and flattened; posterior side a little longer, broadly rounded at its extremity and forming a subangular junction with the hinge line above. Umbones prominent, tumid but rather narrow; beaks incurved, anterior, and almost if not quite terminal; hinge line straight behind the beaks, equal to about two-thirds of the greatest length of the valves beneath.

Surface marked with a few faint and obscure concentric undulations and lines of growth, also by extremely minute radiating lines. Test very thin.

Hinge dentition and muscular impressions unknown.

Ekwan river, portage road at falls: a cast of the interior of both valves, with part of the test preserved.

This shell is rather similar to the *A. affinis of* Ulrich from the Middle Galena of Minnesota and Illinois, both in its shape and surface markings. But, in the former the posterior end is more broadly rounded and not so much produced below, and the radiating raised lines of the surface are much more minute.

Mytilarca pernoides, sp. nov.

Shell compressed convex, rather obliquely subovate and very inequilateral, or broadly mytiloid and subalate behind. Anterior side very short, truncated or abruptly inflected above and rounded below; posterior side a little longer, its outer margin truncated somewhat obliquely and forming an angular or subangular junction with the cardinal border above, but rounded below. Cardinal border behind the beaks straight, its entire length equal to fully two-thirds or more of the greatest length of the valves below; hinge area large; umbones apparently not very prominent; beaks appressed, incurved and almost terminal.

Surface marked with a few impressed and concentric striæ of growth; test rather thick.

Hinge with both cardinal and lateral teeth; muscular impressions unknown.

Ekwan river, portage road at falls: one testiferous left valve.

Mr. Ulrich thinks that this shell is "closely related to, if not quite the same as, *Ambonychia aphœa*, Hall," from the Niagara limestone of Illinois, which he (Mr. Ulrich) referred to *Mytilarca* in 1894, in the seventh volume of the Reports of the Geological Survey of Ohio. *A. amphœa*, however, was based upon a mere cast, which does not show the proportionate length of the hinge line, the size of the cardinal area, nor the surface markings, so that it is scarcely possible to make a satisfactory comparison between it and the specimen from the Ekwan river.

Ctenodonta subovata, sp. nov.

Shell small, inequilateral, moderately convex, subovate and one fourth longer than high. Anterior (?) side short and rounded; posterior (?) side produced, a little longer, and more narrowly rounded at its outer termination; ventral margin gently convex; superior border sloping abruptly downward in front of the beaks and much more gradually so behind them; umbones small and moderately prominent; beaks also small, incurved and placed in advance of the midlength; ligament external, short, placed on the shorter end of the hinge line.

Surface faintly, very minutely and concentrically striated.

Hinge dentition and muscular impressions unknown.

Dimensions of the only specimen collected: maximum length, twenty millimetres; greatest height, fifteen mm. and a quarter; maximum thickness, ten mm. and a quarter.

Ekwan river, portage road at falls: one testiferous specimen, with both valves.

The homologies of the shell of *Ctenodonta* are unknown, and it is not at all clear which is the anterior and which is the posterior side of this species. If the shorter is the posterior side, as in Nucula and as would seem to be indicated by the position of the ligament, then the beaks of this species are placed a little behind the midlength and *vice versa*.

"In outline this shell agrees very nearly with my *C. simulatrix* and less closely with *C. Albertina*, but these species had the ligament on the longer, instead of the shorter end of the hinge." Ulrich.

Gasteropoda

Pleurotomaria (or *Euomphalopterus*) sp. indet.

Ekwan river, upper rapid: five badly preserved casts of the interior of the shell of a widely umbilicated species of *Pleurotomaria* or *Euomphalopterus*, with a very low obtuse spire. These specimens are very similar in shape to casts of *Pleurotomaria Valeria*, Billings, which is probably an *Euomphalopterus*, but the outer whorl of each is not so distinctly keeled at the periphery.

Euomphalopterus, sp. indet.

Ekwan river, foot of portage road: a specimen of the upper half of the shell completely worn away, the basal half, which is all that is left, being narrowly umbilicated and showing part of a peripheral alation.

Megalomphala robusta, sp. nov.

Shell large for the genus, strongly convex but deeply and rather widely umbilicated on both sides, the umbilicus occupying about one half of the entire diameter though its margin is not very distinctly defined. Whorls at least three and perhaps more, increasing very rapidly in size and laterally expanding, coiled closely on the same plane and every where in close contact, but with little or scarcely any overlapping; their periphery encircled by a continuous slit-band; exposed portions of the inner ones truncated almost vertically but somewhat obliquely on each side. Outer whorl rounded on the periphery in some specimens, faintly and obtusely subangular in others, distinctly subangular around the umbilical margin at both sides, the umbilical wall being steep but somewhat oblique. Slit-band narrow, in half-grown specimens moderately elevated and bounded on each side of its summit by a spiral raised line, but this minute double keel becomes obsolete on the outer half of the last volution, in adult shells. Outline of transverse section near the aperture subreniform and much wider than high in some specimens, but somewhat triangular and nearly or quite as high as wide in others; outer lip not preserved in any of the specimens collected, but apparently not abruptly expanded; apertural slit unknown.

Surface of most of the specimens collected marked only with curved, transverse striæ of growth, but in one specimen the markings consist of small, narrow, thin transverse ridges, with flat spaces between them.

Ekwan river, portage road at falls: seven specimens, all of which are imperfect at the aperture. The largest is seventy-two millimetres in its maximum diameter.

The generic name *Megalomphala*, Ulrich, 1897, is, however, too close to *Megalomphalus*, *Brusina*, 1871.

Salpingostoma boreale, sp. nov.

Shell small, consisting of three rounded volutions that are a little wider than high and coiled on the same plane, in close contact, with little or no overlap, or at least closely contiguous if not actually in contact; umbilicus wide and open, exposing most of the inner whorls. Aperture trumpet shaped, lip widely and abruptly expanded.

Surface marked with minute rounded spiral ribs, that are crossed by small, crenate, lamellose raised ridges. The silt-band is not well shown in either of the few specimens collected, but it seems to be narrow, and continuous, at least at some distance behind the aperture.

Ekwan river: middle rapid, foot of portage road, and portage road at falls; one specimen from each of these localities. The largest of these specimens, though only twenty-three millimetres, or less than an inch, in its maximum diameter, has an abruptly expanded aperture. The other two are obviously immature shells, each about eleven mm. in its greatest diameter. In one of them the posterior half of the earliest volution is free from, and not quite in contact with, that which immediately succeeds it.

It is only in the continuity of the slit-band that this species and shells of this genus are supposed to differ from *Tremanotus*, or as Dr. Paul Fischer spells it, *Trematonotus*.

Euomphalus, sp. indet.

Ekwan river, lower rapid: a cast of the interior of part of the outer whorl of a large species.

Gyronema speciosum, sp. nov.

Shell quite large for the genus, imperforate, turbinate, a little higher or longer than wide, spire slightly higher than the outer whorl. Whorls, six or seven, rounded, ventricose; aperture widely subovate, not far from circular, lip thin and simple.

Surface marked with numerous and rather close-set small spiral ridges, that are crossed by still more numerous, more close-set and minute, transverse raised lines. On the last whorl but one there are about eight of these spiral ridges, and on the last or outer one there are not less than twelve and probably as many as fifteen.

Ekwan river, portage road at falls: two specimens. The larger of these was probably about forty-five millimetres high or long, when perfect, and its maximum width is thirty-five mm.

Gyronema Dowlingii, sp. nov.

Shell turbinate, higher or longer than wide, spire elevated, volutions rounded and ventricose; umbilicus almost or quite closed. Lower whorls of the spire marked with three rather distant, acute and prominent spiral keels. Outer whorl encircled by four comparatively large spiral keels and by a few much smaller spiral ridges, or minute raised lines. Between the second and third spiral keels there are three close-set, low and rounded, minute spiral raised lines, and there are indications of a few small spiral ridges in the umbilical region, below the lowest of the four large spiral keels.

Ekwan river, portage road at falls: one imperfect specimen with the apical whorls broken off, but with the test preserved on the last two whorls of the spire, and on part of the outer whorl.

A rather smaller species than the preceding and with very different sculpture. It is somewhat similar in shape to the *Cyclonema sulcatum* of Hall, from the Guelph formation of Ontario (which is probably a *Gyronema* rather than a *Polytropis*). But the whorls of *G. Dowlingii* are not shouldered above, its suture is not channeled, and its outer volution is encircled by only four large spiral keels. *G. Dowlingii* is still more closely allied to, but apparently quite distinct from the *C. cariniferum* of Sowerby, as figured by Lindström in his monograph of the Silurian Gastropoda and Pteropoda of Gotland, which Ulrich says is a *Gyronema*.

Gyronema brevispira, sp. nov.

Shell rather small, turbinate conical and wider than high; spire shorter than the outer volution. Whorls four or five, those of the spire obliquely compressed; last whorl of the spire angulated and carinated below, next to the suture; outer whorl obliquely compressed above, rounded and almost imperforate below, the umbilicus being represented by a minute, short and very narrow chink behind the columellar lip; aperture ovately subcircular; lip thin and simple.

Surface encircled by small narrow and acute spiral keels. On the last whorl but one there are five of these keels, and on the outer whorl eleven.

Ekwan river, portage road at falls: two specimens.

Loxonema, sp. indet.

Ekwan river, at the following localities. Foot of portage road, a specimen of a small slender species, with six whorls preserved; and, upper rapid, a much more imperfect but otherwise similar specimen. Portage road at falls, a fragment of a larger shell, with apparently similar characters, but with only two of the whorls preserved.

Orthonychia obtusa, sp. nov.

Shell straight, conical, slightly compressed at the sides, but more so on the right than on the left side, and moderately elevated, the height being less than the maximum length at the aperture or base. Apex erect, bluntly pointed and rather eccentric; base with two faint, obscure, shallow undulations on the right side. Aperture and outline of transverse section at and near the base, subovate but somewhat irregular in outline; lip shallowly undulated on the right side.

Surface markings unknown, though casts of the interior are quite smooth, and the exterior of large pieces of the thin and presumably inner layer of the test that happen to be preserved is marked with numerous, irregular and often not continuous, fine concentric striæ. Mucular impressions unknown.

Ekwan river, foot of portage road: two specimens, that are very different in shape to any species of *Orthonychia* or *Platyceras* that the writer is acquainted with.

Platyceras compactum, sp. nov.

Shell turbinate, imperforate, a little wider than high, spire small and short. Whorls certainly three and probably as many as four or five in perfect specimens (the apex being broken in both of those collected), rounded, closely coiled and increasing rapidly in size; outer whorl inflated and expanded, with two faint low rounded spiral plications near and at the aperture in young specimens, and from three to four in adult ones.

Surface marked with numerous, close-set, transverse lines of growth, that are flexuous where they cross the spiral plications.

Ekwan river, portage road at falls: one apparently adult and one half-grown specimen. The former, which is well preserved and nearly perfect, is thirty-five millimetres wide, and was probably about thirty mm. high when perfect, allowing two mm. for a small piece broken off at the apex.

Diaphorostoma perforatum, sp. nov.

Shell depressed turbinate, much wider than high; spire short, raised very little above the highest level of the outer whorl; base narrowly but deeply umbilicated. Whorls five, increasing rapidly in size, those of the spire flattened above and rounded below; the outer one rounded and ventricose, but depressed at the suture above; umbilical margin rounded and very indistinctly defined. Aperture rounded subovate, pointed above and slightly insinuated on the columellar side by the encroachment of the preceding whorl, wider and rounded below; lip thin and simple; characters of the columella not well shown in the only specimen collected.

Surface marked with numerous close-set, nearly straight and very minute, transverse raised lines, that are scarcely visible without the aid of a lens; also by a few larger and more distant impressed lines of growth.

Ekwan river, middle rapid: one nearly perfect specimen, with the test preserved.

This shell seems to be referable to the genus *Platyostoma*. Conrad (1842), but Lindström asserts that this name is preoccupied by Klein in 1753, by Meigen in 1803, and by L. Agassiz in 1829. For this reason Dr. Paul Fischer (in 1885) proposed to distinguish Conrad's genus by the name *Diaphorostoma*, though Lindström maintains that both *Platyostoma*, Conrad, and *Strophostylus*, Hall, are mere synonyms of *Platyceras*. Fischer explicitly states that the only difference between *Diaphorostoma* and *Strophostylus* is the obliquely folded columella of the latter, while Eastman, in the first volume of his recently published translation of Zittel's "Text-book of Palæontology," quotes *Strophostylus*, Hall, as a synonym of *Platyostoma*, Conrad.

Strophostylus amplus, sp. nov.

Shell imperforate, subglobose, widely expanded and slightly depressed, about as wide as high, spire small and very short. Whorls four, increasing very rapidly in size, those of the spire rounded; the outer one moderately convex as viewed dorsally, expanded widely in the direction of its height, widest above the midheight and rather narrowly rounded at the base; suture distinctly impressed; aperture very large, apparently widely subovate; outer lip thin and simple; characters of the columella not well shown in either of the specimens collected; posterior portion of the outer lip extended considerably, so as to embrace part of the preceding whorl.

Surface marked with fine transverse striæ of growth, which are curved convexly forward parallel to the outer lip.

Ekwan river, portage road at falls: three specimens, which do not show the exact shape of the aperture at all well. The interior of each is completely filled with stone, so that the inner edge of the columella is covered, but in one of the specimens there are indications of a flexuous longitudinal groove just behind the columella.

Strophostylus inflatus, sp. nov.

Shell subglobose, naticoid, imperforate, about as wide as high, spire short. Whorls probably four in perfect specimens, though not more than three are preserved in the most perfect specimen collected, increasing rapidly in size, the outer one inflated and ventricose, most convex at about its midheight; aperture not well shown in the specimen described, but aparently subovate; outer lip thin and simple, its posterior portion apparently not so extended as to embrace part of the previous whorl.

Surface marked with obliquely transverse lines of growth.

Ekwan river, portage road at falls: a cast of the interior of the shell of a large specimen with small portions of the test preserved, from which the foregoing description was made, and two small specimens; also a large testiferous specimen that is probably referable to this species, though its outer whorl is considerably compressed laterally.

Strophostylus filicinctus, sp. nov.

Shell depressed turbinate and wider than high, spire rather short, less than half as high as the outer whorl, as viewed dorsally. Whorls, six or perhaps seven, rounded but slightly flattened at the suture above, increasing rapidly in size, the outer one strongly inflated, ventricose and imperforate at the base. Aperture subcircular, lip thin and simple.

Surface marked with extremely minute and close-set, low, rounded, spiral raised lines, and by fine transverse striæ of growth. On the last volution but two of one specimen there are nineteen of these spiral raised lines, and four and a half in a millimetre. On the outer whorl of an apparently adult specimen, and near the aperture, there are three spiral raised lines to a mm.

Ekwan river, portage road at falls: two specimens, with the minute surface markings well preserved. One of these is a testiferous specimen with nearly the whole of the spire preserved, but with the outer whorl almost completely broken off; and the other a cast of the interior of the last two whorls of the shell of an adult specimen, with a small piece of the test preserved, at and near the aperture. Beside these there are four specimens that are probably referable to this species, though none of them sow any trace of the minute spiral lines upon the exterior of the test. Three of these are from the portage road at the falls, and one from the foot of the portage road.

This species would seem to be congeneric with *Cyclonema cancellatum* of Lindström, from the Silurian rocks at Gotland, which Ulrich says is a *Strophostylus*.

Cephalopoda

Endoceras (or *Nanno*) sp. indet.

Ekwan river, portage road at falls: two fragments of siphuncles, or of a siphuncle, that are presumed to be referable to either *Endoceras* or *Nanno*, on account of their apparent homologies with specimens collected by Dr. Ells and the writer in 1902 in the Chazy or Black river limestone at Kingston Mills, Ont.

Actinoceras Keewatinense, nom. prov.

This is a provisional name for some peculiar, obliquely subnummuloidal and presumably submarginal siphuncles, or portions of siphuncles, somewhat resembling those of *A. cochleatum* (*Scholtheim*). They are longicone and increase very slowly in thickness, nearly circular in transverse section, and encircled, at more or less regular intervals, by narrow and rather deep, obliquely transverse constrictions. Between these constrictions the siphuncle is laterally compressed and but slightly expanded, while its transverse diameter is from two to three times as great as the distance between the constrictions.

The surface markings of these siphuncles consist of fine close-set longitudinal striæ.

Rainy island, Attawapiskat river, Dr. R. Bell, 1886: three fine and rather slender specimens. Ekwan river, upper rapid: two distorted fragments.

The best specimen, from the Attawapiskat river, which shows ten of the siphuncular constrictions, is three inches and nearly a half in length, by twelve millimetres in diameter near the smaller end, and twenty-two near the larger. In this specimen the width of the siphuncle is about twice as great as the distance between two of the constrictions. In another equally slender but shorter specimen from the same locality, which shows seven siphuncular constrictions, the width of the siphuncle is nearly three times as great as the distance between the constrictions, at the smaller end; and only twice as great at the larger.

Kionoceras cancellatum (Hall).

Orthoceras cancellatum (Hall), 1852.
Orthoceras columnare, Hall, 1866. Not *O. columnare*, Marklin, 1857.
Orthoceras Scammoni, *O. Hoyii*, *O. lineolatum*, and *O. irregulare*, McChesney, 1861; teste Hall.
Orthoceras Woodworthi, McChesney, 1865; teste Hall.
Orthoceras Cadmus, Billings, 1886.
Orthoceras angulatum, Hall, 1867. But not *O. angulatum*, Wahlenberg, 1821.
Orthoceras virgatum, Hall, 1867. Not *O. virgatum*, Sowerby, 1839.
Orthoceras subcancellatum, Hall, 1877.
Orthoceras orus, Hall, 1877.

Ekwan river: portage road at falls, two fragmentary specimens, the largest less than two inches in length; and middle rapid, two similar fragments; all of which seem to be referable to this species. Each of these specimens is a portion of a longicone orthoceratite, with a circular transverse section, a central or nearly central siphuncle, and marked with narrow longitudinal ridges, separated by wider grooves or intervals, with minute, close-set, transverse, raised lines between them. Specimens with similar external characters have been found in the Niagara and Guelph formations at three localities in Ontario and Quebec. These are the *Orthoceras Cadmus*, of Billings, from Grimsby and Elora; a specimen from Elora that the writer has referred to *O. Scammoni;* and a specimen from L'Anse à la Barbe, near Port Daniel, in the Baie des Chaleurs, in the Museum of the Survey, labelled *O. virgatum*, by E. Billings.

O. Cadmus, *O. subcancellatum* and *O. orus* are names that have been given to this shell on the assumption that Hall's *Orthoceras cancellatum* is not the same as the *Orthoceratites cancellatus* of Eichwald. Billings, in a paper entitled "New Species of Fossils from the Clinton and Niagara Formations" and published with his "Catalogues of the Silurian Fossils of the Island of Anticosti," says that his *O. Cadmus* appears to

be *O. cancellatum*, Hall, not Eichwald. And in the explanation of fig. 11, of Plate 19 (10) of the Twentieth Regents' Report, Hall says that the character of the surface of impressions of the exterior of specimens from Wisconsin and Illinois that he figures and refers to *O. angulatum* and *O. virgatum*, is "precisely like that of *O. cancellatum*, Hall, from the Niagara group of New York, and differs in no essential particular from the minute surface markings of *O. columnare*." But Dr. Foord has shown that Eichwald's *Orthoceratites cancellatus* is an *Endoceras*, and the specific name *cancellatum* does not appear to be preoccupied in *Orthoceras*, and certainly is not in *Kionoceras*. And if it be objected that "once a synonym always a synonym," then the next specific name to be selected would seem to be *K.* or (*O.*) *Scammoni*, if Hall's *O. cancellatum* is not the same as the *O. canaliculatum* of Sowerby.

Orthoceras, sp. indet.

Apparently brevicone; longitudinally ridged, ridges unequal in size and irregular in distribution.

Ekwan river, portage road at falls: a fragment that is not sufficiently long to show conclusively whether it formed part of a brevicone orthoceratite or not.

Orthoceras Ekwanense, sp. nov.

Shell increasing rather rapidly in thickness, compressed, elliptical in cross section; surface of the test smooth; septa very close together, siphuncle apparently central, though the internal structure is badly preserved in the only specimen collected.

Ekwan river, portage road at falls: one specimen, a little over two inches in length, and fully two inches in its longer diameter at the larger end. Perhaps a *Rizoceras*, which is possibly an inadvertent spelling of *Rhizoceras*.

Phragmoceras linelatum, sp. nov.

Shell, or cast of the interior of the shell, apparently essentially similar to that of *P. Nestor*, as described and figured by Hall, in general shape and in that of its aperture, but with the exterior of the test marked with very numerous, closely and regularly disposed, minute transverse impressed lines, that give to the surface a minutely ribbed appearance, under a lens.

Ekwan river: middle rapid, a cast of the interior of a large body chamber; foot of portage road, one good specimen and three fragments; portage road, at falls, two good specimens and one fragment; and upper rapid, a large but imperfect cast of the body chamber and of nine or ten of the chambers between the septa.

The type of *P. Nestor* is a mere cast of the interior of the shell, with no indications of the surface markings of the test, and in *P. Nestor*, var. *Canadense*, there are remains of rather coarse longitudinal ribs.

Crustacea

Ostracoda

Isochilina or *Leperditia*, sp. indet.

Ekwan river, upper rapid; a rather large right valve about twelve millimetres long, but with only its interior exposed.

Trilobita

Calymene Niagarensis? Hall.

Calymene Blumenbachii, Billings, pars; but perhaps not of Brongniart.

Small island in the northern Sutton Mill lake: an imperfect head that is probably referable to this species, though it shows little more than a cast of the glabella, which is proportionately wider in front than that of average examples of *C. Niagarensis* from the Anticosti group of Anticosti. The Canadian Calymenes that E. Billings identified with *C. Blumenbachii* are now usually referred to four species, viz., *C. senaria*, Conrad, from the Trenton limestone; *C. callicephala*, Green, from the Hudson river group; *C. Niagarensis*, from the Niagara, Guelph and Lower Helderberg formations and from the Anticosti group; and *C. platys*, Green, from the Corniferous limestone.

Illænus, sp. indet.

Ekwan river: middle rapids, one pygidium; foot of portage road, three glabellæ and four pygidia; portage road at falls, one pygidium. The dorsal furrows of these three glabellæ are well defined, but the shape and position of the eyes or ocular lobes are not well shown in either.

Bronteus Ekwanensis, sp. nov.

Pygidium very large, attaining to a length of a little more than four inches and a little longer than wide, longitudinally and broadly subelliptical but truncated anteriorly, its posterior end being rather narrowly rounded and its lateral margin nearly straight on each side anterior to the midlength. Axis moderately convex, inversely subtriangular, longer than wide, with an obtuse apex, occupying more than one-third but less than one-fourth of the entire length of the pygidium and marked with a transverse groove near its anterior margin. Pleural region most prominent at and near the midlength of each of the pleural ribs, decreasing abruptly in convexity outward to the lateral margins of the pygidium, but much more gradually so to its posterior margin; marked by fifteen large flattened convex radiating ribs, with narrow grooves between them; each rib being narrow at and near the axis and wider at some distance from it, though all the ribs fade out at a short distance from the margin and before reaching it. The median rib is shallowly bifurcate posteriorly.

Surface apparently smooth. Cephalon and thoracic segments unknown.

Ekwan river: lower rapid one, imperfect pygidium; middle rapid, the largest and most perfect pygidium collected; and foot of portage road, one imperfect pygidium and two fragments.

Bronteus aquilonaris, sp. nov.

Pygidium of medium size, apparently not exceeding an inch and a half in width, transversely subelliptical and much wider than long, with an almost flat but slightly convex axis, and still flatter pleural region. Axis short, inversely subtriangular, with an obtuse apex and somewhat concave sides, nearly twice as wide as long, almost smooth but marked with one transverse furrow near the anterior margin; median rib a little wider than any of the lateral ribs and bifurcate posteriorly; lateral ribs seven on each side, straight and flattened convex, all of the ribs fading out before reaching the margin.

Surface apparently smooth. Cephalon and thoracic segments unknown.

Ekwan river: portage road at falls, three pygidia, each with the axis imperfect; and foot of portage road, one pygidium with the axis well preserved.

Bronteus Niagarensis, Hall, from the Niagara limestone of Ontario, has a much larger pygidium, with the midrib entire and contracted at its midlength, while the lateral ribs are wider and flexuous. *B. acamas*, Hall, from "limestone of the Niagara group at Wisconsin" and Ontario (which S. A. Miller says is a synonym of *B. occasus* of Winchell and Marcy) has a much larger and more pointed pygidium, with an "entirely simple" and undivided midrib. *B. insularis* of Billings, from the Anticosti group of Anticosti, is a diminutive species with a pygidium less than half an inch wide and wider than large while *B. Pompilius*, Billings, from the Silurian (Upper Silurian) rocks at Port Daniel, has a small pygidium with a "longitudinal median lobe in the axis."

Ceraurus Tarquinius (Billings).

Cheirurus Tarquinius, *Billings*, 1863. Proc. Portland Nat. Hist. Soc., vol. i, p. 121, fig. 22.

Ekwan river: portage road at falls, and foot of portage road. At each of these localities two heads were collected, which seem to be essentially similar to the types of *C. Tarquinius*, from Port Daniel, in the Museum of the Survey, though the characters of the posterior angles of the cephalon of that species are still unknown. In the Ekwan river specimens the eyes are opposite the second lobe of the glabellæ, the cheeks are coarsely punctured, and each of the posterior angles of the cephalon ends in a short spine.

APPENDIX II

List of plants collected by Mr. D. B. Dowling at the mouth of the Ekwan and Albany rivers, 1891.

By John Macoun, M.A., F.L.S.

Though Mr. Dowling only collected 41 species of flowering plants, the collection is in several respects an interesting one. In the first place no plants had previously been obtained from the west coast of James bay as far north as the Ekwan river, so that the range of every species collected has been extended. No truly Arctic plants were obtained, but on the other hand there were several species which require a temperate climate. Among these are *Lathyrus palustris*, *Rosa blanda*, *Mertensia paniculata* and *Erysimum cheiranthoides*.

One of the most interesting plants in the collection is the rare *Pyrethrum bipinnatum*, only found in Canada in the Hudson bay region. Other interesting species are *Primula stricta*, *Cypripedium passerinum*, *Carex turfosa*, and *Poa alpina*.

1. Anemone multifida, Poir.
2. Anemone parviflora, Mx.
3. Ranunculus circinatus, Sibth.
4. Braya purpurascens, Bunge.
5. Erysimum cheiranthoides, L.
6. Stellaria longipes, Goldie.
7. Lathyrus palustris, L.
8. Hedysarum Mackenzii, Rich.
9. Potentilla Anserina, L. Var. Grœnlandica, Sen.
10. Potentilla fruticosa, L.
11. Fragaria Virginiana, Duch.
12. Rosa blanda, Ait.
13. Rubus arcticus, L.
14. Heracleum lanatum, Mx.
15. Achillaea Millefolium, L., var. nigrescens, L.
16. Artemisia Canadensis, Mx.
17. Erigeron hyssopifolius, Mx.
18. Senecio Balsamitae, T. & G.
19. Senecio palustris, Hook.
20. Pyrethrum bipinnatum, Willd.
21. Taraxacum officinale, L.
22. Primula farinosa, L.
23. Primula stricta, Horn.
24. Mertensia paniculata, Don.
25. Pedicularis Grœnlandica, Retz.
26. Castilleia pallida, Kunth.
27. Pinguicula vulgaris, L.
28. Plantago maritima, L.
29. Cypripedium passerinum, Rich.
30. Habenaria dilatata, Gray.
31. Habenaria hyperborea, R. Br.
32. Sisyrinchium angustifolium.
33. Allium Schœnoprasum, L.
34. Juncus Balticus, Willd.
35. Triglochin maritimum, L.
36. Carex maritima, Mull.
37. Carex turfosa, Fries.
38. Eriophorum polystachyon, L.
39. Elymus mollis, Trin.
40. Poa alpina, L.
41. Poa arctica, R. Br.

RECONNAISSANCE SURVEYS OF

FOUR RIVERS SOUTH-WEST OF JAMES BAY[38]

By W. J. Wilson

Your instructions directed me to explore and survey the country lying between the Attawapiskat and Albany rivers, and also the country between the Albany and Moose rivers on the west coast of James bay. In the first place you pointed out that the Kapiskau river would afford an easy means of access to the former region, and that there was reported to be a canoe route from Moose Factory to Fort Albany which followed branches of the Moose and Albany rivers flowing through the centre of the latter area; also to make a micrometer survey of the Abitibi river from the upper crossing of Niven's line to Moose Factory and to run a micrometer line from the latter point to the crossing of Niven's line on the Moose river.

Itinerary

I left Ottawa on the 24th of May, accompanied by Mr. Owen O'Sullivan of this office as assistant, and proceeded by the ordinary canoe route from Lake Temiskaming to Moose Factory. We engaged two Indians at North Temiskaming and one at Abitibi post who remained with us all summer, and besides these three we employed guides for short periods, who know the different rivers we had to explore.

We reached Moose Factory, June 20, having been delayed very much by stormy weather. We went from Moose Factory to Fort Albany in our canoes along the coast, and after securing a guide and supplies for six weeks we continued in a boat to the mouth of the Kapiskau river, which we reached July 2. We made a micrometer survey of this river for 200 miles up. At this point the numerous short bends in the river made progress so slow that it was deemed advisable to stop micrometer work and separate into two parties. This we did July 21. I followed the main stream, making a track survey for about eighty miles, and I also explored some of the larger branches as far as I could ascend them with a canoe. Mr. O'Sullivan returned to the forks forty-four miles up from the mouth and made a track survey of the south branch called Atikameg (Whitefish) river by the Indians. He continued up this river 135 miles.

Having completed the examination of the two principal branches of the Kapiskau, we returned to the mouth of the Otadaonanis river, a large tributary which joins the main stream four miles from James bay. Here Mr. O'Sullivan remained to make astronomical observations and to extend the micrometer survey out to the bay, while I made a track survey of the branch referred to above. We then returned south, Mr. O'Sullivan making a track survey of the coast between the mouth of the Kapiskau and Fort Albany. At the latter place we again separated to examine the country between the Albany and the Moose rivers. Mr. O'Sullivan went up the Albany to the upper end of Big Island, where a large river, called by the Indians Kwataboahegan, enters from the south. He explored this river to its source. It forms part of a canoe-route between Moose Factory and Fort Albany used by the Indians only at high water, but no one seemed to know whether it would be possible to go through at this season (August 11). The branch which forms the southern part of the route is known by the same name and enters the Moose river about fifteen miles south of Moose Factory, measured along the common canoe-route. The Albany branch is also known by another name which means Stooping river, and to prevent confusion I have used this name on the accompanying map. Returning from Fort Albany to Moose Factory, I made a track survey of part of the coast. On the 16th August, I reached the mouth of Kwataboahegan river, on the Moose side, and began a track survey of it, which I continued for ninety miles up. Having met Mr. O'Sullivan, who was successful in getting through, we completed the examination of this river and returned to Moose Factory, where we repaired our canoes and got supplies for the trip home. Leaving this post early in September, we made a micrometer survey of the Moose river up to the intersection of Niven's line (1898), a distance of thirty-one and a half miles. We then returned to the Abitibi river and continued the survey up that stream to the intersection of Niven's line, at the 179th mile post, connecting with my survey of last summer. This completes the instrumental survey from Moose Factory to Lake Temiskaming by way of the Abitibi river and lake, and the canoe-route to Quinze lake. We finished the survey September 24, and came directly to Ottawa, which we reached October 8.

[38] This report is contained in Vol. XV., part A, pages 222-233, of the Geological Survey of Canada. The exploration was made in 1902.

The Kapiskau River

The Kapiskau is about a quarter of a mile wide for some distance from the mouth and has a width of from seven to ten chains to the forks. At forty miles up, a section was made which showed that the volume of water at this point was 566,000 cubic feet per minute (July 4). The width is seven chains with an additional three chains for ordinary high water, and the greatest depth is eight feet. The current is swift and strong, with frequent rapids, which become more numerous as the river is ascended up to 212 miles. Then for a distance of twenty miles there are only a few rapids and moderate current, followed by thirty miles of swift water and rapids. Above this there is almost still water to the Kapiskau lakes and for some distance beyond. The fall in a few rapids amounts to three or four feet, but for the most part it does not exceed one foot, and many of them are mere ripples which I presume disappear in high water. In the whole distance travelled on this river, we did not require to make a single portage.

The river has no distinct valley, but has cut its way into the thick clay covering that overlies the solid rock or into the soft rock itself. The banks are generally low, rising from five to twenty feet, and usually the land along the river for four or five chains back is higher than that farther away. The sediment deposited by the river when it is swollen by the spring freshets has accumulated year after year and has slowly built up a ridge close to the stream. It is also possible that the ice may have assisted in piling up the material along the banks in the same way that the shooting dykes are formed along the rivers in eastern New Brunswick and Prince Edward island. This narrow ridge is well wooded where not burned, with large spruce, poplar, and at some distance from the coast, canoe-birch, fir, balm of Gilead and an occasional tamarack and cedar. The tamarack here has escaped the ravages of the larva of the imported larch saw-fly that has done so much damage to it farther south, so that where it does occur it is green and healthy. Back from the river, five or six chains, the trees are much smaller and in many places nothing is seen but muskeg thinly covered with stunted spruce and tamarack two to eight inches in diameter, and an abundance of laurel (*Kalmia angustifolia*) and Labrador tea (*Ledum latifolium*).

Banks of Boulder Clay Succeeded by Limestone

For the first 125 miles the banks are composed of bouldery clay and stratified clay and sand containing marine shells. At this distance the first rock exposures appear. The rock is a very soft, reddish-brown, argillaceous limestone mottled with greenish-gray spots, and some layers are wholly of the latter colour. In places layers of the two colones alternate. The beds as far as observed are horizontal. Near the surface where the rock is exposed to the weather it is broken up into small pieces, and when wet very rapidly changes into mud, but in digging down much larger and firmer masses are found. The rock, where first seen and for several miles up the river, is so soft that the river banks are worn down just the same as the clay banks, and no cliffs are seen. This continues up for more than fifty miles from the first exposure, when a considerable change takes place. At the 183rd mile of the micrometer survey a cliff nearly thirty feet high occurs, a section of which is as follows in descending order:—

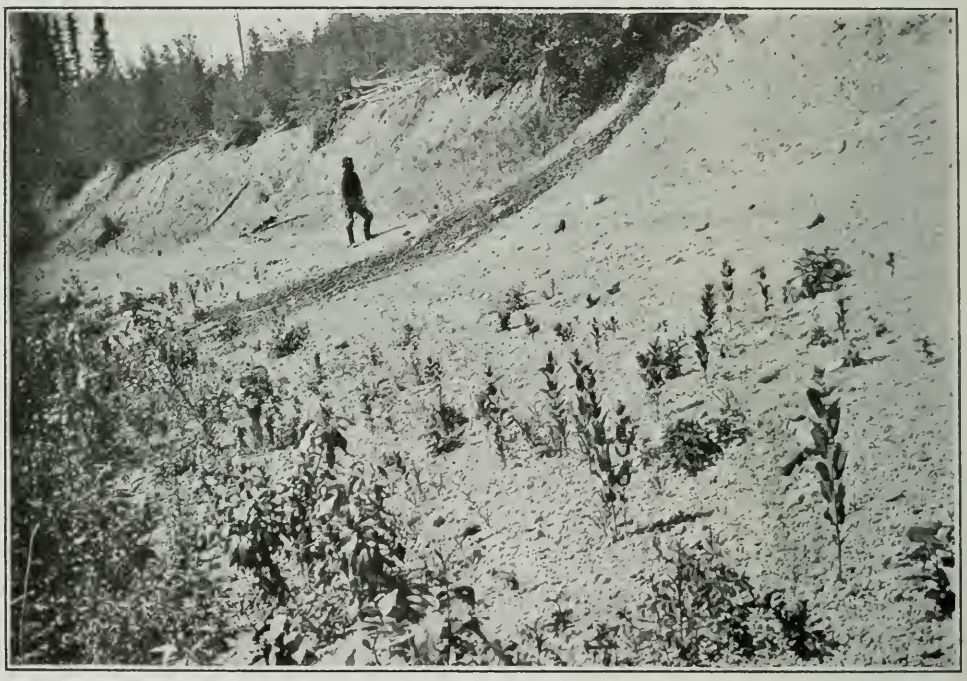
	Feet.
Grayish limestone in angular blocks, firm	3.0
" " " " much broken, soft	1.6
" " " " slightly mottled with red	1.3
" " " " very soft	0.6
" " " " mottled with red, fairly firm	1.5
" " " " very soft	0.7
" " " " mottled with red	1.3
Grayish and reddish limestones very finely broken	0.4
Reddish limestone, mottled with gray	1.8
Grayish limestone, very soft	0.2
Reddish limestone, crumbling	1.2
Grayish limestone, firm	1.0
Mottled reddish and grayish limestone, very soft	1.3
" " " " firm	1.1
" " " " washed and covered by the river at high water	10.1
	26.3

For twenty-two miles above the point where this section was made occasional outcrops of similar rocks are exposed along the banks, but for the last ten miles they are considerably firmer and of a light yellowish or buff colour. This is well seen at the last

micrometer station, 200 miles from the coast. Only one more exposure of rock was seen and that was about five miles farther up the stream, or 205 miles from the bay. These distances are given from the micrometer survey and of course follow all the bends of the river, and this makes the distance much greater than if measured in a straight line. No fossils were found in any of these rocks, but in their lithological characters they resemble very closely the Devonian rocks at the Sextant rapids, Abitibi river, where there are bands of the reddish and grayish rocks which both in the ledge and in hand specimens are identical with those on the Kapiskau river. The rocks on the Abitibi underlie beds containing typical Devonian fossils.

Country Mostly Level Plain

For 175 miles up the Kapiskau river the country is as flat as it can be, and not the slightest elevation is apparent. At the end of this distance, however, the character of the country somewhat changes, and for the next 25 or 30 miles up the monotony is relieved by low hills 75 feet high, which give a rolling aspect to the country. These hills



Clay banks of Kapiskau river. Photo by W. J. Wilson.

were evidently formed by erosion and are comparatively level on the top. This area is drier as the soil contains much sand and is covered for the most part with a thick second growth of poplar and canoe-birch, with many dry trunks of trees standing or lying scattered over the ground. Going west up the river, the land again becomes flat and the current is not so swift or the rapids so numerous, and at 260 miles the stream becomes much broader and forms a lake-like expansion of comparatively still water for six miles, when it opens out into a small shallow lake. This lake is only one mile long and half a mile wide, but is of some importance as it gives the name to the river. When approaching this lake in a canoe there is no channel or passage visible, as it is filled with tall scouring-rushes (*equisetum*), and the canoe has to be forced through these across the lake. The word Kapiskau means obstructed or blocked up, and was first applied to this lake, and afterwards to the river. For the next mile the river flows from the north-west in a sluggish broad stream with marshy banks, and again expands into a narrow lake running north and south for three miles. At the extreme north end, the river enters, and for four miles is almost dead water, after which it has a swift current with occasional rapids as far as it was followed, a distance of seven and a half miles from the lake. At the point where I turned back the river was from 30 to 40 feet wide,

and in places four feet deep, while in other places there was not enough water to float a canoe. It was blocked every few chains with log jams and fallen trees which reach from bank to bank. We had to cut our way through these and this made progress so slow that I decided to return, having first climbed a tree which gave a view of the country for a long distance, and nothing could be seen but a broad plain covered with ragged bush, with an occasional clump of large green trees, mostly spruce, poplar and tamarack, but the area within a radius of five or six miles that is so covered in any one place is small. A small stream enters the largest of the Kapiskau lakes from the west, but it proved to be full of boulders, driftwood and rapids, so that it could not be navigated by canoes for more than a mile.

Half a mile west of the south end of the lake there is a ridge which, though only 75 feet above the level of the lake, stands out prominently from the level country. An examination showed that it is composed chiefly of gravel. It has the form of a kame, and is about 20 chains long and 500 feet wide. It is sparsely covered with Banksian pine, canoe-birch and poplar. Viewed from this elevation the whole surrounding country is a vast plain. The only rise to break the monotony is a slight elevation five or six miles to the north. There is a small lake a mile to the south, and peaty swamps are common. These are covered with small spruce and tamarack, and the drier ground with second growth poplar and canoe-birch. The aneroid readings give an elevation of about 400 feet above sea level at these lakes.

Large areas are covered by peat bogs, especially along the upper stretches of the river, and often the top layer along the almost perpendicular bank is composed of peat four or five feet thick.

On my way down the river I examined some of the larger branches for seven or eight miles up, and found the country in no way different from that adjacent to the main stream.

The Atikameg River

Mr. O'Sullivan reports that the Atikameg river, which he surveyed for 135 miles from the forks, presents the same characters as the main stream. There is a swift current and numerous rapids, and the upper part is very crooked, with many short bends. The banks are composed of bedded and boulder clays and are from ten to twenty-five feet high. The forest growth, close to the river, consists of spruce, poplar, tamarack, canoe-birch and fir. The spruce averages from six to twelve inches, with occasional trees twenty inches or more in diameter. Back five or six chains, from the river banks, the land is open swamp and muskeg, covered with small spruce and tamarack. No rock exposures were seen on the lower part of this river. The first rock in place is 100 miles from the forks, and is a flat-lying, honeycombed, light-yellowish dolomitic limestone. Some of the cavities are partly filled with a white mineral, which on exposure to the air crumbles into powder. Some of the layers are harder and have fewer cavities. A rock of this character is seen one mile and three-quarters farther up the river. Four miles and a half above this, the soft, grayish limestone, already mentioned as occurring on the main branch, was observed. Rocks similar in character to those seen at these three places occur at intervals almost as far as the river was examined. The specimens collected show that some of the strata are much harder than those of the Kapiskau river. Where Mr. O'Sullivan turned back, the aneroid gave an approximate elevation of 375 feet.

The Otadaonanis River

At high water this branch is navigable for canoes almost to its source, and forms a canoe route to the Albany river, by a portage connecting its head waters with the latter.

It is two and a-half chains wide at the mouth, and I was able to ascend it forty-five miles, though the water was comparatively low. Its general course is north-east, and it runs close to the main river, as well as to its principal branch, the Atikameg. The banks are composed of clay containing the usual boulders and shells. No rock exposures were seen, but small heaps of the reddish and grayish mottled limestone were lying on the banks as if deposited there by melting ice pans, and indicate that the rock is probably in place farther up the stream.

The clays exposed along the banks of the Kapiskau and its branches show considerable variety. Near the coast an unctuous bluish-gray clay is overlaid by ordinary sandy clay. Farther up the river, typical boulder clay full of striated boulders occupies the lower part, with more or less stratified material on top. There is no sharp line of separation between them, as they seem to merge into each other. In places there are thin bands of peaty material containing plant remains. Still farther up the banks are higher and the material much more sandy and gravelly, often showing false bedding. Generally the upper layers contain marine shells with few boulders, while the lower part is decidedly bouldery. Thinly laminated limestone concretions are common, usually circular in form,

but as far as examined they contain no fossils. For 125 miles up the river there is no means of estimating the exact thickness of the clay covering, but above this, where it rests upon the solid rock, it varies from ten to seventy-five feet. A section six miles above the forks gives, in descending order:—

Stratified clay	10 feet.
Bouldery clay	20 feet.

The bouldery clay is very much like the overlying stratified clay in general appearance, and is of a dark slate colour, but shows no stratification and contains no fossils.

Limestone fragments, both rounded and angular, are common in the clay; also a dark, very fine-grained argillaceous arkose or graywacké with spheroidal pseudo-concretions of a lighter colour, which by differential weathering are sharply outlined. The cavities thus formed vary in size from mere specks to six inches or more in diameter. In section, examined by Mr. O. E. LeRoy of this office, the pseudo-concretion is seen to consist of angular and rounded fragments of clear quartz and turbid feldspar, shreds of biotite, muscovite and brown sphene imbedded in a matrix of calcite. The centre of the area is occupied by an oval-shaped fragment of fine clay slate. No concentric structure is aparent. The main mass of the rock differs in having a clay or kaolin matrix. These boulders are the most widely distributed and probably the most numerous of all the boulders in the drift, and are found on the west coast of James bay and all the rivers examined in this vicinity. Dr. Bell states that they extend all the way south to Lake Superior, and that the rock is found in place on Long island, off Cape Jones, on the East Main coast.[38a] Besides these there are well rounded boulders of red and gray granite, gneiss, reddish conglomerate containing jasper pebbles, greenish breccia containing pyrite; banded jasper, jaspilyte, several iron ores of low grade; hornblende schists; diorites, etc. Some of the jaspery iron ores are identical, as far as can be judged from hand specimens, with those collected by Dr. Bell and Mr. A. P. Low on the east coast of Hudson bay, and they also resemble very closely iron ores found in situ on Sutton Mill lake by Mr. D. B. Dowling.

The shells, etc., found in the clays of the Kapiskau river, as determined by Dr. J. F. Whiteaves, are as follows: *Saxicava rugosa*, *Macoma calcarea*, *M. Balthica*, *Cardium Ciliatum*, *Mya truncata*, *M. arenaria* *Leda buccata*, *Mytilus edulis*, *Scripes Grœnlandicus*, and *Balanus crenatus*. The shells of *Saxicava rugosa* are very large, one specimen measuring one and seven-tenths inches in length, and three-quarters of an inch in width.

The first two in the above list are by far the most common and are found everywhere. No striæ were observed except on boulders, as the soft rock where exposed had weathered and disintegrated.

James Bay

The most noticeable feature of the west coast of James bay is its extreme flatness. Looked at from a distance there is no distinct shore line, but the water and land seem to merge into each other. A strip varying in width from one to three miles and partly covered with grass and low shrubs, extends along the coast from the Kapiskau to the Moose river, except for a few miles north and south of Cockispenny point, where the shore is fairly high and dry, and the trees come to the water's edge. At this point one can land with canoes almost any time, but elsewhere the water is very shallow, and at low tide, bare mud flats extend out for miles. Gravelly ridges with numerous boulders are very common, and form one of the serious obstacles to canoeing along the coast.

At Cockispenny point I noted the reddish-brown and grayish limestone that has been already described as occurring on the Kapiskau. Farther south at Pisquochi large masses of a light gray and dark buff limestone containing the Devonian fossils *Spirifer divaricatus* and *Streptelasman prolificum* were observed. There seems to be little doubt that these rocks are in situ.

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[38a] Report of Progress, Geol. Sur. Can., 1886 Vol. II (N.S.), pp. 20G and 36G.

The latitude and magnetic declination of the following places are:—

	Latitude.			Magnetic declination.		
Mouth of the Kapiskau river	52	45′	45″	12	10	25′
Mouth of the Atikameg river	52	29	40	..	..	..
200 miles up the Kapiskau river	51	55	0	7	7	36
Fort Albany	*52	14	28	11	45	0
Cockispenny point, James bay	52	0	0	..	..	..
Moose Factory (Ogilvie)	51	14	42	..	..	..
Niven's line (Moose river)	..	..	..	11	0	0
Sand Bank lake, north end of portage	51	3	30	..	..	..

* This latitude is the average of Mr. D. B. Dowling's and ours.

SURVEY OF THE

SOUTH AND WEST COAST OF JAMES BAY[39]

By Owen O'Sullivan

Itinerary

In accordance with instructions to survey and explore the west coast of James bay, I left Missinaibi with my assistant, Mr. W. Spreadborough, on June 13th, with two canoes, and arrived at Moose Factory on June 27th.

In 1898 Mr. Henry O'Sullivan made an accurate survey of the south shore of James bay as far west as Point Comfort, which, in a straight line, is forty miles north-east of the mouth of Moose river. West of Point Comfort, the shore line has been sketched in from track surveys whose absolute accuracy cannot be guaranteed, as it is impossible to follow close to the shore in canoes or boats, owing to the shallowness of the water.

I hired a small sail-boat at Moose Factory to take us across to Point Comfort, but a strong north wind drove us to East point. I therefore sent the boat back to Moose Factory and started a micrometer survey from this point northward to Point Comfort.

After completing this work we returned to East point and continued the survey to Moose Factory and northward to Cape Henrietta Maria. We walked along most of the coast to enable us to follow the high-water line, which was the best marked, but often we had to use the canoes on account of the difficult walking through mud and salt marshes. From Point Comfort to Mesakonan point, a distance of six miles, the shore rises from four to twenty feet above high tide, and shoals are seen up to three-quarters of a mile out. Well rounded gneiss, granite and argillaceous arkose boulders, averaging three feet in diameter, are piled ten feet above high tide at nearly all the points, and short sandy beaches surround the heads of the small bays. The land rises gently and is well wooded with black spruce, tamarack and Banksian pine of from five to nine inches in diameter.

Gull bay extends from Mesakonan southward to Gull point, a distance of seven miles. This bay, which is about four miles across, is very shallow, the tide running out for three miles. A swamp, called Cabbage Willows, extends eastward from the head of this bay across to Rupert bay; there is a trail through it some ten miles in length, which forms part of the winter route between Moose Factory and Rupert House.

Between Gull point and East point, a distance of seven miles to the south-west, the coast is low with mud-flats and boulders. Opposite East point, at about three-quarters of a mile from high-water line, is a reef of boulders which runs south for two miles and is then succeeded by sand and gravel bars as far as the Little Missisikabie river, a distance of six miles. This part can only be navigated with canoes at high tide. From the mouth of the Little Missisikabie to Nattabiska, twenty-seven miles, the shore is very flat and the distance between low and high water mark runs all the way from three to six miles. Hannah bay, at low tide, is simply a mud flat, with the exception of the Harricanaw river channel. From Nattabiska, which is considered the north-west limit of Hannah bay, to Moose Factory, the distance is thirty miles.

The Moose River Delta

The mouth of the Moose river is divided into three different channels; the centre one, passing south of Middleboro island, is reported to be the deepest but last year the Revillon Bros. found a deep channel from the "inner Ship hole," running north of Middleboro island, to within a few feet of the main land on the north bank of the river opposite Moose island. Here they have established a trading post in opposition to the Hudson's Bay Company.

We have only to take into consideration the enormous flow of the Moose during spring freshets, when the ice, occupying 150 miles of a comparatively level, broad river, is suddenly disengaged, carried down with irresistible force and stranded for miles along the coast, to appreciate the fact that the delta at the mouth of this river is subject to remarkable annual changes.

From the mouth of the Moose river northward, the shore continues low with mud flats and boulders as far as two miles beyond Pisquanish, which is thirty-one miles from Moose Factory. Then long reefs of boulders, sand and gravel bars extend seaward as far as Nomansland, 60 miles from Moose Factory. In this last stretch there are some

[39] This report is contained in Vol. XVI., Part A, pages 173-179, of the Geological Survey of Canada. The survey was made in 1904.

points of land, made up of gravel and sand, that have an elevation of twenty feet above high tide. At Half Way point and Cockispenny one may land with canoes at any time.

Between Nomansland and the Albany river four small rivers enter the bay; the largest, named Kinoje, has a flow of about 8,000 cubic feet per minute. This river has not cut out any channel in the mud, and can be reached with canoes at high tide only.

Mouth of Albany River

The tide between Nomansland and the Albany river runs out three miles. The Albany is the largest river entering James bay on the west coast. It has several channels at its mouth, the deepest passing north of the island on which Fort Albany is situated. Fort Albany is ninety-six miles from Moose Factory.

North of the Albany river the coast is very flat and the walking bad; we were compelled to use the canoes as far as Ekwan point, which is eighty-five miles north of Fort Albany. In this stretch, in which the difference between high and low tide is sometimes five miles, we could see nothing but mud, strewn with boulders. Between the Albany and the Ekwan, two large rivers enter the bay. The Kapiskau in Lat. 52° 45′, was surveyed by W. J. Wilson in 1902, and, thirteen miles north of it, the Lowasky, a branch of the Attawapiskat, debouches. This river was surveyed by Dr. Bell in 1886.

The Attawapiskat Estuary

The Attawapiskat enters the bay through five separate channels; the third, north of Lowasky, is the deepest, and on it, six miles from the mouth, the Hudson's Bay Company has an outpost. There is also a Roman Catholic chapel.

North of the Attawapiskat, the water continues shoal to the mouth of the Ekwan riven and some distance beyond. Shoals are seen three and four miles from high-water line all along. The Ekwan is 180 miles from Moose Factory and was surveyed by D. B. Dowling in 1901. Ekwan point, six miles north of the Ekwan river, is composed of coarse sand and gravel and has an elevation of fifteen feet above high tide. The water at this point is comparatively deep and there is only a distance of sixty feet between the high and low tide marks. Ordinary tides rise about seven feet.

Ekwan Point to Raft River

From Ekwan point to Raft river the distance is twenty-nine miles; the coast continues low with mud-flats. Raft river had an approximate volume of 10,000 cubic feet per minute when we crossed it, August 9. The water was then very low. It is navigable for canoes for about ninety miles to its source in two small lakes.

Opinnagau and Lakitoosaki Rivers

Forty-five miles north of the Raft river, the Opinnagau enters the bay, and ten miles north is the mouth of the Lakitoosaki. These rivers have about the same volume, 20,000 cubic feet per minute, and are navigable for canoes for some considerable distance. The coast from the Raft to the Lakitoosaki becomes more sandy with fewer boulders, but the tide still runs out from one to two miles from high-water mark.

Sixteen miles north of the Lakitoosaki, the Big Owl river enters the bay; it is two chains wide at low tide and had an average depth of three feet at the time we crossed it (August 16). This river can be ascended with canoes for a short distance only.

Eight small streams enter the bay between Ekwan river and the Big Owl river. These streams become wider and shallower at their mouths, and their channels through the mud-flats that appear at low water are so wide that we had to drag our canoes, drawing only fourteen inches, up one of the channels for two miles in order to reach the shore.

Mud Flats Strewn with Boulders

The most easterly point of Cape Henrietta Maria is eighteen miles northward from the mouth of the Big Owl river and 300 miles from Moose Factory, following the sinuosities of the coast. This part of the coast is flanked by sand and gravel bars, some having an elevation of twenty feet above the tide mark, the water being deep right up to the shore. We terminated the survey at the east point of Cape Henrietta Maria in latitude 54° 51′ 30″, and we planted a post recording my name and date, August 18. Northwest from this point the shore is extremely flat, and, when the tide was out, we could see nothing but mud-flats strewn with numerous large boulders.

Inland from high-water mark we generally found a strip of low dry mud, in places a mile wide, and covered with grass, with occasional sand and gravel bars. To the rear of this, a fringe of alders and juniper-bushes, of from ten to sixty feet wide, reaches the spruce swamps and muskeg areas, which, I believe, is the character of the ground

overlying the Devonian and Silurian formations extending for 150 miles west of the James bay coast.

In latitude 54° the spruce woods recede from the shore in a north-westerly direction and the coast continues north to the mouth of the Opinnegau river, then north-east to Cape Henrietta Maria. The country lying between the northern limit of trees and the cape is a barren, dry and gravel plain with sandy knolls and fresh-water ponds.

Only two exposures of rock in situ occur on the west coast of James bay, one at High Rock point, latitude 51° 23', which reaches one foot above high tide, and the other, at Pisquanish, is seen at low tide; both are fossiliferous Devonian limestone lying horizontally.

There is little doubt that the coast of James bay is rising slowly. Among the facts noted the following may be mentioned. In several places, well defined elevated beaches are distinctly traceable for several hundred feet back from the present high tide mark. In some places the old cedar driftwood is discernible fully ten feet above the level of present high tide mark, and still above and beyond these appear other ranges of sand debris traceable through the densest part of the forest bordering the bay.

Speckled trout, Albany river waters. Photo by W. J. Wilson.

Fauna and Flora

Game was very plentiful; black ducks by the thousand breed in the southern part of Hannah bay, and the pintail and teal in even greater number, breed north of the Albany. A few ptarmigan were shot near Cape Henrietta Maria, and, on our return, a large number of geese were also shot.

Speckled trout and whitefish, averaging three pounds in weight, are caught in nets at the mouths of all the rivers.

At Ekwan point, while having lunch, I counted over one hundred porpoises passing close to the shore. Seals were often seen, and numerous skeletons of walruses and seals were lying on the beach north of the Albany.

Whales were not seen during the expedition, probably owing to the shallowness of the water all along the western coast of James bay; but in 1898, as assistant with my father, we surveyed the east coast from Rupert House to East Main Fort. There the

water is deep, and the bay is studded with many islands, between which whales and porpoises were often seen playing.

The weather was most favourable. During the whole time, from June until September, we accomplished the work with two eighteen foot canoes, and did not lose more than three or four days on account of bad weather.

Gardening is carried on successfully at Moose and Albany. We never had better potatoes than those from Albany. At Moose, cabbages, radishes, lettuce, pumpkins, cucumbers, carrots, turnips, etc., grew luxuriantly.

My assistant, Mr. W. Spreadborough, made a large collection of plants during the season and prepared a list of the birds seen. The list of birds, with notes on their breeding habits, will be published in my complete report. Professor Macoun has made the following summary report on the plants, and the full list will be included in "The Flora of the Hudson Bay," soon to be published by this Department.

"Mr. Spreadborough's collection of plants, numbering 278 species, includes all that were known to occur in the region examined, and many species not before recorded from that district. Though there appear to be none new to science, several species are of great interest or rarity. The more noteworthy of these are *Linum Lewisii* var. *Stenophyllum*, a white-flowered species of flax only known before from one locality, near Fort Severn; *Potentilla Egedii*, which had until recently been confounded with *P. Anserina; Pyrethrum bipinnatum*, rediscovered on the coast of Hudson bay a few years ago; *Arnica foliosa*, a long way out of its usual range; *Gentiana Macounii*, known before in that region only from poor specimens collected at Rupert House, together with many species of willows, grasses and carices of rare occurrence.

"The flora as far north as Albany is in great part made up of species characteristic of the sub-arctic forest region, but from Raft river to Cape Henrietta Maria there is a considerable admixture of species more arctic in their character. No truly arctic species were collected, however. The collection is so complete that little, if anything, more remains to be done botanically along the coast between Moose Factory and Cape Henrietta Maria."

My thanks are due to the Hudson's Bay Company's officers whom I met in the course of my expedition, and I may mention in particular Mr. George McKenzie, chief officer in charge of the district.

I also wish to thank Rev. Mr. Holland and Mrs. Holland of Moose Factory, Mr. and Mrs. Christie of New Brunswick post, and the Reverend Fathers of the Albany Mission for pleasant hospitality.

JAMES BAY[40]

By A. P. Low

Introductory

James bay is that portion of Hudson bay lying south of a line drawn from Cape Henrietta Maria, on the west, to Cape Jones, on the east coast. From the head of Hannah bay, north latitude 50° 55′, to Cape Henrietta Maria, the distance is, roughly, 300 miles, while the average breadth is 145 miles.

From Cape Henrietta Maria the coast runs south-south-east to Mourning point, a low point covered with trees, near latitude 54° 38′, then south to Equan point, latitude 53° 53′; from there it trends well to the westward, to the mouth of the Equan river, and then east of south to the mouth of the Albany river, latitude 52° 17′, thus forming a considerable bay, and not running almost due north and south as represented on all modern maps.

From the mouth of the Albany river the direction of the shore line changes to east-south-east for a distance of forty miles to Cockespenny, when it turns south-east to the head of Hannah bay. Hannah bay is thirty miles deep, counting from a line drawn between Gull point on the east side and the mouth of Moose river, and has an average breadth of fifteen miles.

This bay is separated from Rupert bay by a long, low point, terminating in a peninsula, at one time an island. The isthmus is covered with willows and is lower than the land adjoining. The latter, on both sides, supports a thick growth of spruce and tamarac. Rupert bay is thirty-five miles deep, with an average width of twelve miles.

The east coast of James bay has a roughly north and south direction from the head of Rupert bay to the mouth of Big river, one hundred and seventy-five miles. From this river the coast takes a gradual curve to the westward, the land at Cape Jones lying about east and west.

According to Capts. Taylor and Bishop, of the Hudson's Bay Company's ships, the position of Cape Jones, as laid down on the Admiralty chart, is fully forty miles to the eastward of its true position; this being the case, the mouth of James bay is that much narrower than is represented on the maps.

The Admiralty chart, from which all modern maps of Hudson bay are constructed, was compiled in 1853 from information supplied by the Hudson Bay Company, gathered from notes and observations of the various captains of their ships; now as these observations were but approximately correct, the chart must be so also, especially in those parts unfrequented in the navigation of the bay, and such being the case, it is highly important that an accurate survey should be undertaken to correct these errors in the coast line, and enable ship captains unacquainted with the navigation of these parts, to enter James bay with a certain degree of safety, a thing impossible with the present charts.

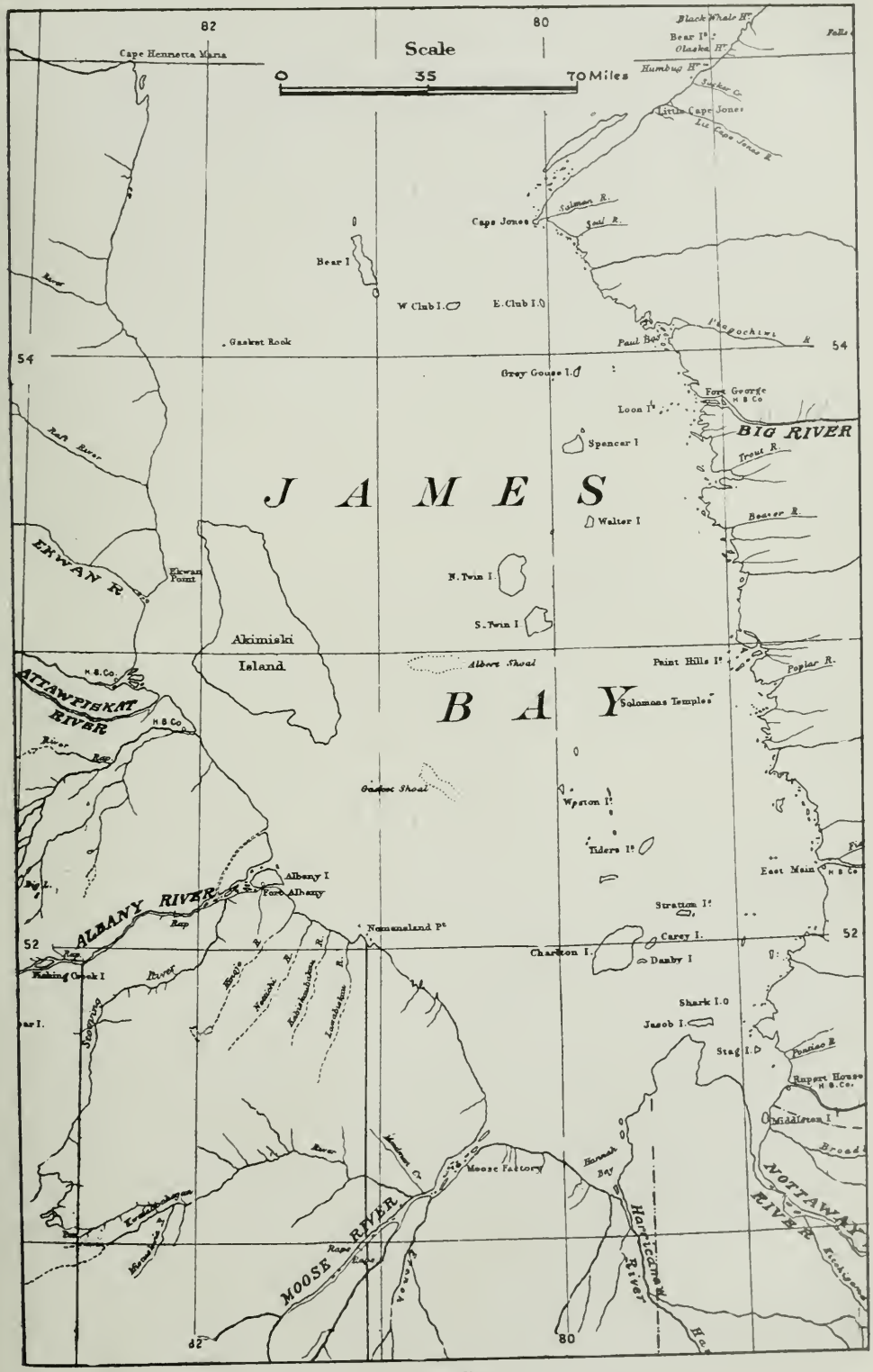
South and West Coast Lines Low and Flat

The general coast line of the west and south sides of James bay is low and flat, with shallow water, deepening very slowly outwards all along, except where the rivers have cut out channels in the mud.

Although the average rise and fall of the tide does not exceed five feet, at the time of low water, only mud flats, strewn with large boulders, can be seen to seaward from high water mark. The shore is, in most places, marshy, covered with grasses and willows, with numberless small brackish ponds and lakes for a considerable distance behind high-water mark, while beyond, on slightly higher ground, is a dense growth of dwarfed black spruce and tamarac; it is often several miles from low-water mark to where the first really dry ground may be found.

Hannah bay is so shallow that, with the exception of the river channels, it is almost completely dry at low water, and when a canoe is left by the tide, the sensation experienced by its crew is anything but pleasant, as they have to debark and stand in the mud, often beyond sight of the low fringe of bushes on the high water line, awaiting the return of the water. Rupert bay is not quite so shallow as Hannah bay, and has a channel up its centre to the mouth of the Nottaway river.

[40] This report is taken from Vol. III., Part J, pages 14-37, of the Geological Survey of Canada, 1887.


Scale
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82
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54
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Cape Henrietta Maria
Black Whale Hr
Bear Is
Olaska Hr
Falls
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Tucker C.
Little Cape Jones
Lit Cape Jones R
Salmon R.
Cape Jones
Seal R.
Bear I
W Club I.
E. Club I.
Gasket Rock
Paul Bay
Pagochiwa R
Grey Goose I.
Fort George H B Co
Loon I.
BIG RIVER
Spencer I
Trout R.
J A M E S
Beaver R.
Walter I
Eastmain R.
Eastmain Point
N. Twin I.
S. Twin I
Akimiski Island
Albert Shoal
Paint Hills I.
Poplar R.
B A Y
Solomons Temples
ATTAWPISKAT RIVER
H B Co
Gasket Shoal
Wpston I.
Tidere Is
East Main H B Co
Albany I
Fort Albany
ALBANY RIVER
Nemeneland Pt
Stratton I.
Carey I.
Charlton I.
Danby I
Shark I.O
Jacob I.
Stag I.
Pennise R
Rupert House H B Co.
Middleton I
Broad
Moose Factory
Harricana R.
NOTTAWAY RIVER
MOOSE RIVER

James Bay.

East Coast Higher

Along the east side of the bay the character of the coast changes, the low unbroken, muddy shores being replaced by higher rocky and sandy banks, deeply indented with small bays and fringed with innumerable rocky, shingle and sand islands as described by Dr. Bell (Report of Progress 1877-8). The waters are much deeper and, although not free from danger on account of many hidden shoals, can be easily navigated in small craft, the islands and bays affording abundance of good shelter.

Character of Country Inland

The country inland from the bay varies similarly to the coast line. To the west and south it is almost flat, with its soil overlying nearly horizontal beds of Silurian and Devonian limestones for about one hundred and fifty miles inland to the Archean country, so that the general level rises slowly and evenly towards the interior. The soil along the rivers appears to be good, and as the climate to the southward is probably favourable for the growth of cereals and root crops, nothing prevents future settlement in this region after the filling up of the north-west, except that without an extensive system of drainage, the lands remote from the rivers will be found too wet for successful farming, as it is said by the Indians, that with the exception of lands close to the rivers, the greater part of the country for a long distance inland from the bay is a mossy swamp.

Inland from the east coast the country is of a different character. The interior of this part is a rough table-land, having an elevation of about seven hundred feet above sea level near its edge, and slowly rising inland to over two thousand feet at its highest.

The edge of this table-land leaves the coast to the north of Cape Jones, and runs in a south-south-east direction, so that to the southward there is an interval, varying from ten to thirty miles between it and the coast. In this portion the general level is not much over one hundred feet above the sea, and the soil is of post-Pliocene clays and sands, with alluvium, affording good land for cultivation, but as the climate is colder than on the west side, it is doubtful if it would allow the successful growth of any but the hardiest cereals. Good crops of potatoes, however, and other roots could be, and are grown as far north as the mouth of Big river. The land is rolling and broken by low, rocky Archean hills which make up about one-third of the entire area, all of which would make excellent grass land. The best portion of it is along the river bottoms, and on the islands and banks.

Rivers Tributary to James Bay

Eleven large and many smaller rivers flow into James bay; on the west side are the Equan, Attawapishkat, Albany, and Moose rivers; on the south, Hannah bay or Harracanaw, and the Nottaway rivers; on the east, the Rupert, East Main, Old Factory, Big and Bishop Roggan rivers.

The water-shed of the country on the west side runs in a south-west direction from Cape Henrietta Maria, and consequently the rivers to the southward, having greater drainage areas, are the largest and longest.

The first river to the south of Cape Henrietta Maria is Raft river, an inconsiderable stream, the outlet of Raft lake; it reaches the sea in latitude 54° 04′.

The next river is the Equan, a much larger stream, which takes its rise 300 miles to the westward, at the water-shed between it and the Winesk river, flowing north; it enters the bay at latitude 53° 38′.

About latitude 53° 24′ are the two mouths of the Attawapishkat river, which rises over four hundred miles inland, near the source of the east branch of the Severn river. It flows north, and drains an extensive area of unexplored country between the Equan and Albany rivers.

The Kapiskau river is a smaller stream, entering the bay at latitude 53° 05′.

The next important stream to the southward is the Albany river, the longest and largest on the west side of James bay.

This river, one hundred and forty miles in a straight line south-west from its mouth, divides into two branches. The north or main branch comes from the west; it takes its rise a short distance from the head-waters of the English river, in Cat or Catfish lake, about one hundred miles north-west of Lake St. Joseph, through which it flows, and which flows into Lake Winnipeg. The south or Kenogami branch flows from Long lake, thirty miles from the north shore of Lake Superior. At its mouth the Albany spreads out and flows between a number of low, swampy islands, forming a delta twenty-three miles long and ten miles broad, between the mouths of its channels, the most southward of which empties into the sea in latitude 52° 12′.

At the south-west angle of the bay is the wide mouth of Moose river, whose branches drain all the country to the south-west and south, from the rivers flowing into the eastern portion of Lake Superior and the head-waters of the Ottawa. The western or Missinaibie branch flows out of Missinaibie lake, at the head of the Michipicoten river, within fifty miles of Lake Superior; the middle or Metagami branch flows from the south, and drains the country north of the watershed to Lake Huron; the eastern or Abitibbi branch flows out of Lake Abitibbi a short distance from Lake Temiscamingue on the Ottawa river.

All the rivers flowing into the west side of James bay present the same physical characters: on their headwaters and upper parts, while flowing over Archæan rocks, they alternate between long lake-like expansions with little current, and short contracted portions accompanied by heavy rapids and falls, thus affording good stretches of navigable water with portages between. On their lower courses, for a distance of one hundred and fifty to two hundred miles from their mouths, where they pass over the flat Devonian and Silurian limestones, the fall is uniform, and consequently the character changes, so that in ordinary low water during the summer and early autumn, owing to this uniformity of fall and to the rivers having too great a breadth for the amount of water discharged at this period, they present an almost unbroken succession of small, shallow rapids, full of boulder and gravel bars, and only navigable for canoes of light draft.

For three or four weeks after the ice leaves the rivers, during the spring freshet, and again after the autumn rains, the higher water flattens out these numerous rapids and covers all obstructions, so that navigation with large boats, and even small steamers, is then possible; but at these times the current has a uniform rate of between five and six miles an hour, and therefore, comparatively powerful steamers would be required to ascend the streams, the boats at present used being tracked up by men along the banks.

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Harbours

In relation to the future settlement of the country around James bay and to the possibility of its use as a highway for future commerce between western Canada and Europe, the question of its harbours and their terminal facilities for railways is of the greatest importance. It is to be regretted that the natural harbours at the mouths of the different rivers in the southern part of the bay meet the requirements of modern shipping only to a very moderate degree, and that to improve them sufficiently to admit of their being used as ports by large ocean steamers would entail an expenditure hardly likely to be warranted by the trade development of the future of this region.

Mouth of Moose River

The most important harbour in this part of the bay is that at the mouth of Moose river. A description of it is given in Capt. Coate's notes on the geography of Hudson bay, 1727-51, and as it has changed but little since then, his sailing directions may here be quoted: "From the Gaskitt, fifty-eight miles S. by W., you come to Moose "river road, eight miles from Sand Heads, North Point, W.N.W., six miles in latitude "51° 34', where you wait for the tide to go into that wide-mouthed river, which is not "less than twelve miles over from North Point to the opposite side; which opens with "three channels, but the north and east are so choked with banks and shoals there is no "using them; the mid channel will admit of a ship of twelve feet. Observing the tide "over a bar one mile broad, and one mile within Sand Heads is a little place which "affords water for a ship to be afloat, called Little Ship Hole, to distinguish it from "another four miles above Sand Heads, called Ship Hole, in three fathoms low water, "where we moor and do our business. Eight miles below the factory on Roberson's "Islands from Middleborough (island), another island runs a shoal within half a mile "of the ship, which cuts the river and prevents the ship going to the factory, which has "plenty water all above that place."

From this it will be seen that a ship, while waiting the tide to cross the bar, has to lie six miles from the mouth of the river, in a very dangerous position with a north-east gale. The channel on the bar is not over four hundred yards wide, and the Hudson Bay Company's ship, drawing fourteen feet of water, last summer, ran aground while crossing it, and had to remain in that exposed place until the next high tide.

The eight miles from the Ship Hole to Moose factory is in places very shoal, and is rapidly filling in its upper part, so that the Company's schooner, drawing eight feet of water, can only come within about two miles of the factory; whereas a few years ago her cargo was discharged close alongside that place. If a railway should be built to this harbour its terminus will need to be at Ship Hole; and to reach it a long

and expensive line of embankment will have to be built from the south shore, across sand and mud flats, partly bare at low water, and, owing to its exposed position, it would need to be correspondingly strong to withstand the force of water during the late fall gales. If approached from the north side, a large bridge will be required to cross the channel to the " Ship Sands," a low, flat, muddy island, partly covered with water at high tide, and lying close to the Ship Hole; in either case the terminus will have to be built largely on made ground.

As the present anchorage, six miles without the bar, is in only thirty-six feet, and as the water gradually shoals toward the river's mouth to a depth of fourteen feet at high water on the bar, and is only eighteen feet at low water at the Ship Hole, with a less depth of water for the four miles between it and the bar, it will be seen that to fit this harbour for the entrance of moderate-sized steamers, with a draft up to twenty feet, extensive dredging operations will be necessary for almost the entire distance from the outer anchorage to Ship Hole.

Unsatisfactory as are the natural conditions of Moose harbour, those at the Albany and Rupert rivers are worse. Off the mouth of the Albany, for fifteen or twenty miles, the bottom is very flat and the deepest water not over twenty-five feet, slowly shoaling to twelve feet at the mouth, with numerous obstructive shoals and bars, the whole rendering it impossible for deep draft vessels to use it. The country around the mouth of the river is so low and swampy that it is hard to say where the land ends and the sea begins, and is totally unfit for the purpose of a railway terminus. To reach the mouth of the Rupert a narrow channel in Rupert bay must be followed, with water from thirty to twenty-five feet deep, after which it shoals to eighteen feet for seven miles to the junction of the Nottaway and Rupert river channels, and then eight miles of water varying from ten to fifteen feet, with dangerous shoals, must be passed to enter the river proper.

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Islands

Akimiski

The islands of James bay, from their geographical position and physical character, may be conveniently divided into three groups. The first consists only of the large island of Akimiski, lying off the western shore; the second includes the high drift islands, situated to the eastward of a line drawn through the middle of the bay, and separated from Akimiski on the west by a deep water channel; the third is composed of the rocky islands and sandy shoals along shore on the east coast. The island of Akimiski, or Omer's island, as it was called by Governor Bayly in 1673, is the largest in James bay, being seventy-five miles long, with an average breadth of ten miles.

Its south end lies about thirty-five miles N.-E. from the mouth of the Albany, and is consequently about twenty-five miles directly east from the coast.

The eastern shore of the island runs N.-N.-W. for thirty-five miles from its south end, and then bending more to the westward runs W.-N.-W. to its north end, which is in Equan bay, and distant about eight miles from the mainland, so that the position of the island is inaccurately laid down on the present published maps, which show it lying roughly parallel to the coast and about fifty miles distant from it. Indians coming from the northward to Albany on the ice in the winter, when travelling in a straight line from Equan point to the mouth of that river, cross the north end of Akimiski, showing that part to lie well inshore. The island closely resembles the adjoining mainland in physical character, being very low and swampy. The shore line above high-water mark is made up of muddy flats, covered in part with grasses and sedges, followed farther inland by thick growths of small willows, these in turn giving place to small black spruce and tamarac as slightly higher ground is reached. The line of these trees is often over two miles inland from high-water mark, itself a long distance from the sea at low water. As far as the tree line, and in places beyond it, are numerous small lakes and ponds of brackish water; good fresh water being only obtainable in a few places well inland.

The shore between high and low water mark is composed of a stiff, slimy mud. Scattered over it are many boulders of gneiss, large and small. At the various points the boulders are often piled together, forming higher elevations than the surrounding flats.

The water around the island is very shoal for several miles out, and as the bottom is uneven, being broken by numerous boulder shoals and bars, it is very dangerous to approach even with small boats, owing to the dirty state of the water. In fine weather the first notice given of these shoals is the bumping of the boat upon them. On the west side, between the island and the mainland, the water is shallower than on the east side, so that at low tide the distance between shore and shore is reduced in some

places towards the north end to not more than one mile. This is taken advantage of by the Indians, several families of whom hunt on the island, crossing from the mainland to the island in their small canoes. They start from shore at high tide and follow the retreating water out to its lowest point, cross the narrow channel, and reach the high-water line on the opposite shore with the rising water. From its close resemblance physically to the western mainland, it is probable that Akimiski is underlaid by the nearly horizontal beds of Devonian limestone found on the rivers near the coast. If this is the case, the rocks are covered with drift material on the lower half of its east side, which is the only part of the island that has yet been examined geologically.

The fresh and brackish lakes and ponds on the island are favorite breeding places for ducks and geese, which congregate here in countless numbers in the autumn to feed on the grasses growing along the low shores. The snow goose is reported to breed here when delayed on its passage north in the spring. Rabbits and cariboo are reported to be numerous, white bears frequent its shore, and the fur of the otters killed here is remarkably good and dark. Owing to the shoal character and muddy state of the water around the island, few fish are caught along its shore.

Charlton Island

The principal islands composing the second group are Charlton, Danby, Carey, Woods, Little Charlton, Stratton, Weston, Solomon's Temples, Twins, Spencer, Walter and Grey Goose islands, along with the Bear islands, lying more to the westward. These have a close resemblance to one another both in formation and physical appearance, being composed wholly of sand, clay and boulders, with no bedded rocks in place. They all rise to considerable elevations above the sea level, present sharp escarpments composed of clay and sand along their margins, and the formation of all was probably due to the same causes, as shown later on in this report.

Charlton, the second largest island in James bay, lies about twenty miles north of Point Comfort, the end of the peninsula separating Rupert from Hannah bay, and about one-third of the distance across the bay from the east coast, its north-east point being in lat. 52° 2′ 13″. In shape it is an oblique parallelogram, having diagonals 18 miles long from north-east to south-west, and twelve miles long from north-west to south-east. As before stated, this island, like the others of the group, is composed of unstratified sand, and clay and boulders, without any rock in place.

The interior is a rough, rolling plateau, varying in elevation from 50 to 200 feet above sea-level. On the south and east sides it ends in an abrupt escarpment, highest on the south; on the west and north the high interior land descends with an unbroken slope to a low shore. Starting from South-east Point, this escarpment runs westward at an angle of twenty degrees to the shore, consequently on its west side it is a considerable distance inland. At the east end it has an elevation of seventy-five feet above sea-level. This increases for four miles, where the maximum elevation of 200 feet is reached, fifty feet above the general level of the interior plateau, and standing above it with a cut bank that height on the north side, one-quarter of a mile from the southern margin of the escarpment, beyond which it decreases slowly westward, and is lost in the general low level of the west side. The face of the escarpment was examined at several points along its length, and found to consist of a moderately fine, light sand, with some clay, coarser gravel and small boulders mixed through the mass, the whole showing no signs of stratification. Going north from the south-east point for one mile, the escarpment averages sixty feet in elevation, with its base within a few yards of high-water mark. Behind this, at a distance of 200 yards, is a second escarpment, thirty feet higher than the first. These, on their face, have the same composition as the southern escarpment. At the end of this course, and for one mile and a half beyond to House Point, the descent from the interior is less precipitous, the land rising in three terraces—the first, ten feet; the next, forty feet, and the highest one, a quarter of a mile inland, 100 feet above the sea.

From House Point for half a mile the face of the twenty-foot terrace is made up of sandy clay, with much gravel and boulders, rising out of deep water. From here the escarpment turns N. 30° W. for five miles, and then east five miles and a half, passing inland around the head of a low, muddy bay, and reaching the shore again one mile south of the north-east point.

Here, on the east side, two distinct terraces are visible, the lower being fifteen and the higher seventy-five feet above the sea. The face of the inner terrace is chiefly sand, mixed with a considerable quantity of clay, and with many boulders scattered through the mass. To the westward of the north-east point, along the shore, the lower terrace is soon lost in the upper one, which, a mile beyond the point, shows a face of forty feet, composed of an unstratified sandy clay matrix, holding large quantities of boulders and coarse gravel.

Farther to the westward the cut bank gradually loses its elevation, and two miles beyond the last described place is only about ten feet high; from here to the south-

west point no banks occur, the shore line being low, and formed of sand and mud, with many loose boulders scattered over it. At frequent points along this part of the shore the boulders are heaped up together, thus rising a few feet above and breaking the monotony of the general level of the shore.

Most of the boulders are of Laurentian and Huronian gneisses and schists, associated with light yellow fossiliferous limestones of Devonian and Silurian age, non-fossiliferous, light and dark limestones similar to those found at Lake Mistassini and along the coast to the north of Cape Jones, and also masses of the dark green traps found associated with the latter rocks.

From the base of the escarpment on all sides numbers of clear, cold springs of excellent water issue at all seasons. Following the shore from the south-west point, the course is due east for half a mile along a sandy beach, about fifteen feet above high water, covered with many boulders near the point; then, turning N.-N.-E., a similar sandy shore, covered with coarse grass and low willows, is passed over for one mile and a half to a flat, muddy bay; this bay, with another on the west side, leaves at high tide only a low, narrow neck joining the south-west portion of the main island. From this bay the course of the shore changes to S. 70 E., and runs in this direction seven miles to South-east Point. Between the escarpment on the south side of the island and the shore is a considerable area of low, swampy land, not rising over ten feet above high-water mark, where a low embankment, averaging twenty feet broad, composed chiefly of boulders bedded in clay, has been pushed up by the floating ice, and forms a natural dyke to the lower land behind, which is very swampy, and partly covered with long, narrow, fresh water lakes lying parallel to the escarpment and shore. Between high and low tide on this side is a wide mud flat, strewn all over with a great number of boulders. Beyond low-tide mark the water is very shoal for a long distance out; with the exception of the stretch of coast on the east side, from South-east to half a mile beyond House Point, the above description of the shore applies to the whole of Charlton island. To the westward and northward sand and boulder shoals, bare at low water, extend out for miles from the island, rendering it impossible for ships to approach from those directions.

The bay on the east side with the escarpment passing around it, already mentioned, is two miles and a half wide and one mile deep; at low water it is completely dry and exposes a broad mud flat, with many large boulders upon it.

The land between the water and the escarpment, like that on the south side, is very low and swampy, with over one-half its area covered by small shallow lakes, formed or enlarged by numerous beaver dams, upon the three small streams that flow into this bay.

To the eastward of Charlton lie two small islands; the southern, called Danby, being two-thirds of a mile distant; the northern, or Carey, two miles from Charlton.

Between these islands and Charlton is a deep channel, through which the tide runs, with a current varying from three to five miles an hour. At House Point the water is deep close along the shore, and it was here that Captain James wintered his ship in 1631; here, also, in 1675 the Hudson's Bay Company's ships discharged their cargoes from England, and took in the furs brought from the different forts on the bay in sloops. In 1695 this depot was abandoned, and the anchorage has since been used only by the Company's ships when obliged to winter in the bay, as it is the only moderately safe place in the southern part of James bay where a ship may winter and allow the crew to obtain good water and fuel. The last ship wintered here in 1884; remains of the low huts, partly built in the ground for the officers and crew, are to be seen about one-quarter of a mile south of House Point on the first plateau island, near a fine large spring of clear water, which never dries or freezes, and is consequently available throughout the year. On the point is the frame of a large shed, formerly covered with sails, in which the ship's cargo was stored. The only drawback to this place as a wintering ground is that the strong current setting up and down the channel causes it to open early in the spring, and it then carries large masses of ice forward and backward, which, striking the ship, are a source of great damage and danger.

The soil of the high interior land being light and sandy, the rain readily soaks in, and consequently no lakes or streams are found on the surface, which is partly covered with moss. The trees growing in the interior are chiefly small white and black spruce, with a few aspen and balsam poplar, growing much thicker to the northward than on the southern parts, where they form open glades, the intervening spaces supporting a growth of small birch (*Betula pumila*) from one to two feet high. About one-half of the south-eastern portion of the plateau has been burnt over, leaving nothing but the bare sandy plain with small patches of moss growing on it, and presenting a very barren appearance. Between the escarpment and the shore, also on the low swampy lands on the west side, the trees are almost wholly made up of black spruce, with a few tamarac and balsam poplar. Fringing the shore are extensive areas of low willows, beyond which grasses and sedges alone grow over these portions at or

near high-water mark, where the shore is frequently overflowed by the tide.

Cariboo and black bears in small numbers are found on the island; white bears often land after heavy gales on its northern shores; rabbits are very plentiful, but the island is chiefly known for the beavers that abound in all its small lakes, being preserved by the Hudson Bay Company, who claim to have introduced them, and only allow them to be hunted every third or fourth year. The small lakes are favourite breeding places for ducks and grey geese, which find good feeding ground on the low grassy flats along the shore; ptarmigan also breed on this island, it being their southward limit around Hudson bay.

Danby and Carey Islands

Danby island, as before mentioned, is distant two-thirds of a mile from the southern portion of the east side of Charlton island. It is roughly triangular in shape, each side having a length of two miles; one side lies parallel to Charlton, with its middle directly opposite House Point. Its shores are low and made up chiefly of sand and boulders with muddy stretches between the points, and a raised bar of sand and boulders formed by ice, similar to that of the south side of Charlton, runs around the island near high-high-water mark. Shoal water extends out from the north, east and south sides for long distances. The interior of the island is low and swampy, covered with a thick growth of small black spruce and tamarac, with a few balsam poplar.

Carey island lies two miles north-east of Danby and three miles east from the north-east point of Charlton. It is four miles long from north to south, with an average breadth of one mile. On the western side the island is low and swampy, gradually rising inland. On its south, east and north sides are escarpments rising in the highest parts seventy feet above the sea. On the east side a raised beach of some fifteen feet in elevation runs along the shore, and extends inland from one to four hundred yards, to an escarpment fifty feet higher, which has a face and top almost wholly composed of water-worn boulders, averaging nine inches in diameter, and without glacial striæ; they are packed tightly together in a condition similar to that shown by boulders on shoals at present, acted upon by the grounding and shoving of large masses of ice over them.

On the north and south sides, the face of the escarpment is largely composed of sandy clay, with large numbers of boulders scattered through the mass. The island on its lower parts is wooded with black and white spruce and a few white birch and poplar; the top of the boulder escarpment is devoid of trees, and has a very barren appearance.

The Stratton Islands

Lying N. 65° E., seven miles from the north-east point of Charlton, is the western end of two small islands called the Strattons.

The western or larger island is five miles long from east to west, one mile and a half broad in the middle, and tapering to a point at either end; the smaller island is nearly round, with a diameter of one and a half miles. The deep channel with its strong current that passes through the sound between Charlton, Danby, and Cary islands, continues across the open bay on a N.-E. course, and runs between the Stratton islands, and from these follows on the same course to near the mouth of the East Main river, where it turns northward and is lost along the coast. The channel between the Strattons is one-third of a mile wide, and is obstructed at its south entrance by a small, low boulder island, one-half mile in circumference. The current, owing to the confined limits of the channel, rushes through at a higher rate of speed than in the Charlton sound, varying from four to six miles an hour.

The channel between the Stratton islands has been tried as a wintering ground for a ship by the Hudson Bay Company, but it was found that the ice carried along on the strong current caused great damage to the vessel; the crew also suffered greatly from the ravages of scurvy, brought on it is said by the use of the stagnant water in the small lakes on the islands, where no running streams exist.

On all sides of these islands, with the exception of the above narrow deep channel, the water is very shoal, with an uneven bottom covered with sand and boulder shoals, some of which are bare at low water, but the greater number, coming within a few feet of the surface, only show their presence by the breakers upon them during gales.

The highest point of the interior of the larger island is seventy-five feet above the sea. On the south side the slope from the highest level is very gradual, and is broken by low rounded hills of boulders lying transverse to the shore line, where they terminate in short points; to the westward a raised beach twenty-five feet high, formed chiefly of boulders thickly packed in clay with sandy patches, extends back about one-

quarter of a mile to a second abrupt bank of packed boulders thirty feet higher. On the lower beach is an immense rounded boulder of red Laurentian gneiss, fully ten feet cube, and consequently weighing over eighty tons.

On the east side along the sound, and partly on the north side, tightly packed boulder banks rise almost perpendicularly ten to forty feet from deep water, and resemble, when examined closely, a built, dry stone wall, while at a short distance they have the appearance of an exposure of solid rock. Along the remainder of the shore and inland are immense numbers of boulders in sandy clay, showing that the greater part of the island is made up of them.

The smaller island is low, being formed chiefly of boulder clay, with sandy shores covered with boulders on all the points. Both islands are scantily wooded on their lower parts with small white and black spruce and willows; numerous fresh and brackish ponds are situated on these parts also.

Little Charlton Island

Bearing N.-N.-W. fifteen miles from the western point of the Strattons is the eastern end of another small island, at present called Little Charlton or False Charlton, but named Trodiley island in Capt. Coates' notes.

This island is very similar in composition and size to the larger Stratton island, except that it is made up of finer material and fewer boulders than that island. Its greatest length from east to west is five miles and a half, with an average breadth of one mile. The north-east part of the island is the highest, and rises fifty feet above the sea. On the eastern half of its south side is a raised beach of sand and gravel ten feet high, extending from the water inland from one to three hundred yards, to a steep sloping bank of sand and boulders twenty feet higher, after which the land gradually rises towards the interior. The western part of the south shore is low and sandy and gradually rises inland towards the east, with no cut banks; the western extremity ends in a low, narrow boulder point, half a mile long. The north shore is covered with boulders or coarse gravel, except short stretches in the bottom of the small bays, which are sandy. Beyond the middle of the north shore, and from there to the east point the island rises abruptly inland, having banks of thirty to forty feet, composed almost wholly of small and large boulders mixed with quantities of clay and sand, from the base of which issue small streams of clear, cold water.

The western end of the island is devoid of trees, and shows a barren, sandy soil, covered with low Arctic plants, with numerous large boulders strewn over the surface. The south-eastern portion is covered with small white spruce trees, not more than ten inches in diameter at the base and less than forty feet in height, which grow in open glades, the sandy soil here being covered with deep moss.

About half way between the Strattons and little Charlton are two small, low islands, composed of sand and boulders, with low willows growing on their highest parts; many sand and boulder shoals also are to be seen in this part of the bay.

Solomon's Temple

Twenty-two miles distant, on a N. 35° W. course from the east point of Little Charlton island, is the next high island, with its north end in lat. 52° 30′ 32″, called Weston island on the present chart of the Hudson Bay Company; this island is named Solomon's Temple in Capt. Coates' notes, while four low islands a few miles to the northward, at present marked Solomon's Temple, he calls Lord Weston's islands; it is proposed to return to the old names, and call the large bold island Solomon's Temple and the low islands Weston islands.

Solomon's Temple is a narrow island, eight miles long from north to south, in the form of a crescent, convex on the west side, and terminating in long narrow points, made up of immense numbers of boulders packed tightly together. On the west side, rising gradually from either point, is a cut bank of sandy clay full of small boulders, having a face of fifty feet in its highest parts. Behind this bank the surface of the island is an undulating plain, covered with many boulders, and dotted with small shallow lakes, which fill every depression of its surface. With the exception of a few solitary stunted white spruce, no trees grow on the island, its surface being covered only with low Arctic flowering plants, grasses, sedges and mosses. Two miles beyond the north point, and seemingly an extension of it, is a small low boulder island, about one mile in circumference.

Rising of Land Around James Bay

On the northern end of Solomon's Temple great quantities of driftwood are heaped up from ten to twenty and occasionally thirty feet above ordinary high-water mark; on the shores of all the other islands similar piles of wood are found, most abundantly on their north sides; that on the higher levels is generally greatly decayed and com-

posed chiefly of cedar. The presence of these piles of driftwood at such high levels has been taken as evidence of a rapid elevation of the land around Hudson bay. Dr. R. Bell places the rate of upheaval of the land, or "subsidence of the water," at from five to ten feet a century. Other evidence than that of the driftwood is required to sustain such a theory, as its presence at these high levels above ordinary tide may be accounted for in another manner than by a rapid elevation of the shores and islands. Owing to the shallow state of the water near the shores of the islands and mainland of James bay, the wind, when blowing on the land, has great effect in causing abnormal rises of tide by forcing the water from the deeper parts of the bay over the shallows; an instance in case was observed by the writer while anchored on the east side of Akimiski island in a moderate gale from the north-west, August 8th, 1887. Here the ordinary rise of the tide does not exceed five feet, yet, after beaching his boat at 8 p.m., by midnight the water was twelve feet deep, showing a rise of seven feet at least above the ordinary level. From this it is easy to believe that extraordinary gales in the late autumn, at long intervals apart, would back the water into the bay to such an extent as to cause a rise of tide from ten to twenty feet above its ordinary level. These high tides, accompanied by great breakers, would necessarily throw the older and lighter wood, then on a high level, farther back, and pile newer wood in front and below it, thus forming a state of affairs as at present seen.

Other facts tend to disprove a rapid elevation of land around James bay, at least in its southern part. Capt. Coates, in his notes on the mouth of the Moose River, written one hundred and fifty years ago, describes it as it exists at the present time, with little or no change in the state of the channel or shoals; if a rise of five or ten feet a century was occurring during this time, the mouth of the river would necessarily be greatly changed, and the shallow flats of Capt. Coates' time would be ten or fifteen feet above the sea. Another place where comparison between levels at different dates can be made is the isthmus connecting the peninsula at the end of the point dividing Hannah from Rupert bay. At present it is a low, muddy neck, covered with willows nowhere five feet above high-water mark, and distinct from the higher land on either side, which is covered with spruce and tamarac. Now, if the change of level claimed were actually taking place, this peninsula two hundred years ago would have been an island, with a considerable depth of water over the present isthmus, but on a map (Parte de la Nouvelle France, Hubert Jaillot, 1696), this very peninsula is marked, thus affording good evidence against a rapid change of level of this part of James bay.

The Tiders and Westons

Between Little Charlton and Solomon's Temple are seven or eight small low islands, formed of sand and boulders, and covered with low bushes on their higher interior parts; these islands are called the Tiders.

The Westons are four low drift islands, thirteen miles N.-N.-E. from Solomon's Temple, in lat. 53°. The largest is about seven miles long, and on its western end the Hudson Bay Company had a ship wrecked in 1724.

South Twin Island

Thirty-six miles N. 10° W. from Solomon's Temple, in lat. 53° 4', is the south-east point of the South Twin island. This island is pentagonal in shape, with its face to the southward; it is seven miles long from north to south, with an average breadth of five miles. Starting from the south-east point, the shore line for one mile and a half northward passes along the base of a steep cut bank of boulder clay, containing an admixture of sand, and varying in elevation from forty to sixty feet. From here the shore turns westward, passing around a bay, one mile and three-quarters wide by one mile and a half deep; the cut bank runs one mile farther inland; low mud flats, covered partly with small brackish ponds, occur between it and high-water mark. Again approaching the shore on the north side of this bay the escarpment gradually changes to low rounded hills, sloping inland, composed chiefly of boulders, with a shore line as far as the north point formed of numerous boulder points, with low muddy bays between, covered with grasses.

Between the north and west points, four miles, is an escarpment, composed of boulder clay and gravel, forty feet high, running parallel to a shore, alternating between boulder points and sandy bays. From west to south-west point the shore line is low and of the same character as that above, with the ground rising slowly inland. Along the south side sand and clay greatly predominate; a cut bank one-quarter of a mile inland gradually rises to an elevation of forty feet near the south-east point, with a lower raised beach of ten feet in front, the latter composed of sand, the former of boulder clay.

The interior of the island rises gradually towards the centre, where it has an elevation of one hundred feet above the sea.

Small lakes fill all the depressions on its surface. With the exception of some four or five stunted white spruce, less than ten feet high, no trees grow on the island, which is everywhere covered with mosses and Arctic plants.

A fine example of the expansive power of ice may be seen half a mile inland from the south-east point, where there is a small shallow lake, at present completely drained by a small stream, which has cut out a channel through the escarpment. This old basin is nearly round, with a diameter of five hundred yards, and had a depth of about six feet. Around the old shore line is a bank of boulders and clay, four feet high and eight feet wide at the base, overgrown with vegetation, and resembling the entrenchment of a fortified camp. This has evidently been pushed up by the total freezing of the lake and the expansion of the ice.

Scattered over the surface of the island are great quantites of small, angular fragments of light yellowish fossiliferous Silurian limestone, the probable result of the breaking up of large boulders of the same.

North Twin Island

Separated by a channel five miles wide, and lying four miles to the westward of this island, with its south-west point in lat. 53° 4′, is the North Twin. Like the other island it has an abrupt escarpment on the east side, with a low shore line on the west rising slowly inland. From the south-west point along the south side, the low shore is composed of sand and gravel, with a wide margin of swampy land extending inland to the slowly rising interior. Low cut banks occur near the coast at the south-east point, where two terraces of ten and thirty feet elevation are seen, the lower formed of sand and gravel, the upper of boulder clay and sand.

On the east side is a wide, shallow bay, with low swampy land, from a quarter to a half-mile inland, to the base of a boulder clay escarpment fifty feet high. On the northern part of the east side a low terrace, fifty feet high, composed of sandy clay, with a few boulders, rises near high-water mark, and extends inland on an average a half-mile to a second terrace thirty feet higher, and of similar composition. On the north side the land adjoining the shore is made up of sandy dunes dotted with boulders, rising slowly inland, with numerous boulder points along the shore. Along the west side the shore margin is low and swampy, with sand and gravel beaches between boulder points, the latter becoming more numerous to the southward. The banks on this side are generally sloping, with a few cuttings of sandy clay full of small boulders.

Inland, the ground rises irregularly towards the centre, where it is lower than the South Twins. The surface is dotted with many small lakes, and covered with a low Arctic vegetation.

From the north-east point a low narrow bar of boulders, partly bare at low water, runs out in a north-east direction several miles towards Spencer Island.

The rising and falling tide rushing over this bar forms a strong rapid, with heavy breakers. Another reef extends from the south-east point, five miles in a S. by E. direction; a ship was wrecked on it in 1732. On the north point is the wreck of a large sloop belonging to the Hudson Bay Company, lost here in 1886, while under the charge of some Esquimaux engaged in killing white bears on the islands. In the bay on the east side a small ship's boat, painted white, was found, which must have been lost from some vessel engaged in the whale fishery in the northern part of Hudson bay, as no such boat has been lost by the Hudson Bay Company.

Walter Island and Emily Rock

Walter island lies ten miles N. 40° E. from the north end of the South Twin. It is nearly round, with a circumference of two miles, and rises with steep banks to an elevation of sixty feet at the highest point. It is almost wholly made up of boulders, which are everywhere tightly packed by ice on the sides and top of the island.

Between Walter island and the South Twin, six miles from the latter, is a small bare knob of Laurentian gneiss, called Emily rock, rising in the middle fifteen feet above high-water mark, with a circumference of fifty yards. The gneiss is dark flesh red in colour, and made up of dark red orthoclase, with some quartz and black hornblende. It contains lenticular masses of hornblende. Strike N. 30° W.

Spencer Island

Spencer island is fourteen miles distant from the north end of the North Twin, on a N. 50° E. course. This island is one mile and a half long by three-quarters of a mile broad, with a generally steep shore line covered with boulders. On the south side is a sandy bay, showing three areas of ten, twenty and fifty feet elevation, the two lower having cut faces of sand and gravel, the highest being formed of small rounded boulders tightly packed together, the same extending over a greater part of the southern interior. On the east side is another sandy bay, with a raised beach of

that material fifteen feet in elevation. In this bay twenty-eight empty oil casks were found, which were probably from the same wreck as the boat on the North Twin, the Hudson Bay Company's people knowing nothing about them. To the northward the island is lower and the boulders fewer, with more intermixed sand. On the west side a wall of boulders rises directly from the water to elevations varying from twenty to fifty feet. All these islands are frequently visited by polar bears, who land to rest after heavy gales, and feed on the Arctic berries that grow in great profusion everywhere; Arctic foxes are also quite plentiful.

The other islands of this group were not examined, but it is inferred from information obtained from the Hudson's Bay Company's officers, and Capt. Coate's notes, that they are of similar origin and composition to those above described.

The Eastern Archipelago

The islands of the third group in James bay lie along the east coast, and have been described by Dr. R. Bell in the report of Progress of the Geological Survey, 1877-78, as follows: "The majority of the islands are rather low, and composed of boulders and shingle, with few or no trees, but the solid rock occurs upon a large proportion of them. No regularity can be detected in the general arrangement of these islands. They present a kind of labyrinth which it would be very difficult to map with accuracy and which is not unlike that of the Georgian bay, Lake Huron, except that on the east coast of James bay the water is shallower, and shows evidence of receding rapidly, and the islands are, as above stated, mostly covered by boulders and shingle."

Meteorological Data

From the meteorological observations taken during the summers 1887 and 1888 the following summary is compiled:

Three daily readings with the minimum temperature, taken on fifty-eight days in 1887, while on James bay, give a mean temperature of 55 degrees.

Similar readings on fifty-one days in 1888 give a mean temperature of 53 degrees. In 1887, there was fog on twenty and rain on fifteen out of fifty-eight days.

In 1888 fog occurred on twenty-eight and rain on twenty-four out of fifty-one days.

Of one hundred and fifty-three observations on the direction of the wind taken in 1887, twelve were from the N., sixteen from N.E., four from E., twenty-two from S.-E., seventeen from S., twenty-five from S.-W., twenty-one from W., and thirty-six from N.-W., the resultant direction being due west.

Two hundred and twenty similar observations in 1888 give a resultant direction of S. 87° W. Three daily readings of the thermometer at Moose Factory during the months of June, July, August and September, give the following mean temperatures: 1878, 61.7°; 1879, 54.3°; 1880, 56.2°. These taken with the mean temperatures given above would give an average mean summer temperature of 55.5°. This would be slightly higher than an average for the entire bay, as the mean temperature of Moose Factory is higher than many other places. Dr. R. Bell, in Report of Progress, 1877-78, places the average temperature of the sea along the east coast at 51°. This is much higher than the temperature of the main body of water, as the water of the east coast is warmed by the rivers flowing into the bay on that side, and being very shallow has its temperature raised by the action of the sun's rays. The difference in the vegetation growing on the outer islands and in the same latitude on the mainland shows that the temperature of the former is much lower than that of the latter, and this is due to the lower temperature of the main body of water, which is so cold that an immersion of the limbs for a few minutes at any time produces a numbness in the parts of the body so covered.

GENERAL ACCOUNT OF HUDSON BAY[41]

INCLUDING A DESCRIPTION OF THE HARBOURS

By Robert Bell

In the popular mind Hudson bay is apt to be associated with the polar regions; yet no part of it comes within the Arctic Circle, and the latitude of the southern extremity is south of London. Few people have any adequate conception of the extent of this great Canadian sea. Including its southern prolongation, James bay, it measures about one thousand miles in length, and is more than six hundred miles in width in its northern part. Its total area is in the neighborhood of 500,000 square miles, or upwards of half that of the Mediterranean. It is enclosed by the land on all sides, except the north-east, where it communicates by different channels with the outer ocean. The principal or best known of these is Hudson strait, which is about 500 miles in length, and has an avertge width of about 100 miles.

Central Drainage Basin of North America

Hudson bay, which might have been more appropriately called Hudson sea, is the central basin of the drainage of North America. The limits of this basin extend to the centre of the Labrador peninsula, or some 500 miles inland on the east side, and to the Rocky mountains, or a distance of 1,300 miles, on the west. The Winnipeg basin constitutes a sort of outlier of the region more immediately under notice, since the waters drain into it from the north, south, east and west, and discharge themselves by one great trunk, the Nelson river, into Hudson bay. The southernmost part of this basin, namely, the source of the Red river, extends down nearly to latitude 45°. The head waters of the southern rivers of James bay are not far to the north of Lake Huron, while one of the branches of the Albany rises within twenty-five miles of the north shore of Lake Superior. Including the Winnipeg system, the basin of Hudson bay has a width of about 2,100 miles from east to west, and a length of about 1,500 miles from north to south, and its dimensions approach the enormous area of 3,000,000 square miles. Over a great part of this region there is a temperate climate, and although the soil of much of it is comparatively barren, yet large tracts are very fertile. The numerous rivers and lakes of the first class embraced within these limits will prove of great value in the settlement of the country. Both the bay and strait are remarkably free from rocks and shoals which might interfere with their free navigation. The groups of islands near the east side of the bay are surrounded by deep water, and a wide channel leads up the centre of James bay. Fortunately the main body of the great bay, which is the portion which may hereafter be frequented by shipping, is entirely without shoals, reefs or islands. The depth is very uniform over most of the bay, and nowhere does it present any great irregularities. It averages about seventy fathoms throughout, deepening to one hundred and upwards in approaching the outlet of Hudson strait; while in the strait itself the soundings along the centre vary from about 100 to upwards of 300 fathoms. The bottom appears to consist almost everywhere of boulder clay and mud. Near the shores a stiff clay, affording good holding ground for anchors, is almost invariably met with on both sides.

James Bay

James bay begins at Cape Jones, on the east side, and Cape Henrietta Maria on the west, and runs south about 350 miles, with an average breadth of about 150 miles. The east side of Hudson Bay, including its southern prolongation, is known as the Eastmain coast. Between Cape Jones and Cape Dufferin, on the Portland promontory, and again in approaching Cape Wolstenholme, at the termination of this coast, the land is high and bold, some points attaining an elevation of nearly 2,000 feet above the sea. The country on the south-west side of the main bay, as well as that lying to the west of James bay, is low and generally level, with shallow water extending a long distance out from shore. Both sides of Hudson strait are high and rocky, but the northern is less precipitous than the southern.

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[41] From report of 1879-80, pages 27-34 C and 35-38 C, of the Geological Survey of Canada.

The Tributary Rivers

Of the numerous rivers which run into Hudson bay from all sides, about thirty are of considerable magnitude. All those which enter on the Eastmain coast appear to flow in a uniform course directly west, or parallel to one another, and as the height of land in the centre of the Labrador peninsula is farthest inland towards the south, the rivers which fall into the southern part of this coast are the largest, and the remainder become progressively smaller as we go north. Numerous streams converge to the head of James bay from all points southward of an east and west line passing through its southern extremity. The Moose, about a mile wide, is the principal of these. On the western side, the Albany and the Churchill rivers are the longest, but the Nelson, with a course of only about 400 miles, discharges the greatest body of water into the sea. Indeed, this huge artery of the Winnipeg system of waters may be considered as one of the greatest rivers of the world. Few of the rivers of Hudson bay afford uninterrupted navigation for large vessels to any great distance from the coast. During the season of high water shallow-draft steamers might ascend the Moose and two of its branches for upwards of 100 miles. Hayes river and two of its branches might also apparently be navigated by such craft in the spring to points about 140 miles inland, and the Albany for nearly 250 miles; while larger steamers might ascend the Nelson for seventy or eighty miles from the open sea. The Nelson is the only muddy-water river entering Hudson bay. Most of the others have a slightly brownish tinge, but their waters are perfectly wholesome, and contain only very small quantities of foreign matter. The Churchill, which is the second largest river of Hudson bay, is a beautiful clear-water stream, somewhat larger than the Rhine. It is remarkable for having at its mouth a splendid harbour, with deep water and every natural advantage for the purpose of modern commerce.

Harbours of Hudson Bay

The only harbours on the west side of Hudson bay are those formed by the mouths of the rivers, but none of them, with the exception of Churchill harbour, can be entered by vessels drawing more than ten or eleven feet, and only at high water even by these. The Nelson may form an exception to this. Most of its estuary becomes dry at low tide, but a channel runs through it near the centre as far as the head of tide-water. I sounded this channel in a number of places in 1878, 1879 and 1880, and although an average depth of about two fathoms at low-water was found, continuous soundings throughout might have shown interruptions or shallower water in some places. As stated in previous reports, there is a section at the head of tide, or between the tidal portion and the regular inland channel of the river, in which not more than ten feet of water was found. This may extend for about two miles, above which an apparent continuous channel, with a depth of about twenty feet, according to our soundings, extends to the lowest limestone rapid, which is the first break in the navigable part, and is between forty and fifty miles from the head of tide, or from seventy to eighty from the open sea. If the section referred to were deepened, steamers coming in from the sea might enter this part of the river and find perfect shelter, or even proceed up the stream to any point below the rapid referred to. In continuation of the channel running down the estuary, a "lead" of deeper water extends out into the bay, and forms the "North river," or "York roads," with excellent anchorage.

The Churchill, unlike all the other rivers, has a deep, rocky and comparatively narrow mouth, which can be entered with ease and safety by the largest ships at all stages of the tide. On the point at the west side of the entrance of the harbour stands the old "Fort Prince of Wales," which is probably the largest ruin in North America. Although occupying a commanding position, and mounting about forty large guns, it was surrendered, without firing a shot, to the French Admiral, La Perouse, who destroyed it, in 1772.

Along the west coast the rise and fall at spring tides amounts to about eleven or twelve feet, on an average, and is pretty uniform, diminishing somewhat towards the south. It is greatest at the mouth of the Nelson river, where it amounts to about fifteen feet. The tides are lower all along the east side of the bay. In Hudson strait there is a very good tide, according to the report we have received of Acting Staff-Commander J. G. Boulton's reconnaissance during the past summer.

Geology of Hudson Bay Basin

Geologically, the basin of Hudson bay, excluding the western or Winnipeg division, lies within the great Laurentian area of the Dominion. Cambro-Silurian rocks, resting almost horizontally upon these, form an irregular border along the south-western side of the bay; and in the valleys of some of the rivers they extend inland

from one to two hundred miles. To the south and west of James bay the Cambro-Silurian are overlaid by Devonian rocks, which here occupy a considerable area. The long chains of islands which fringe the east coast for nearly 300 miles to the northward of Cape Jones, and also the mainland in the vicinity of Richmond gulf, are composed of bedded-volcanic and almost unaltered sedimentary rocks, resembling the Nipigon series of the Lake Superior region, which may be of Lower Cambrian age. On the western side of the bay, from Churchill northward, quartzites and other rocks, which may also belong to the Cambrian system, appear to be largely developed. Valuable minerals may be looked for on this coast. The extensive level region around the south-western side of the bay is overspread with a great sheet of boulder clay, which is generally covered by the modified drift. The rocks of the outlying or Winnipeg division of the basin comprise an extensive series, ranging from the Laurentian to the Tertiary.

Resources of the Region

The resources of Hudson bay and the country immediately around it are varied and numerous, although, as yet, few of them are at all developed.

Furs

The fur trade is the principal and best known business which has hitherto been carried on in these regions; but a considerable amount of oil, derived from the larger whales, the porpoises, walruses, white bears, and various species of seals which frequent the northern parts of the bay, has been carried to New England, and small quantities, principally of porpoise and seal oil, have from time to time been taken to London by the Hudson's Bay Company. The trade in oil might be greatly extended in these quarters. Other articles have been exported from the bay, but hitherto only in trifling quantities. They embrace whalebone, feathers, quills, castoreum, lead ore, sawn lumber, ivory, tallow, isinglass, and skins of seals and porpoises.

Fisheries

The fisheries, properly speaking, of Hudson bay have not been investigated. Both the Indians and Eskimo find a variety of fish for their own use, and fine salmon abound in the rivers of Hudson strait. From one or two of them a considerable number of barrels, in a salted condition, are exported every year by the Hudson's Bay Company. Water-fowl are very numerous on both sides of the bay, and larger game on the barren grounds in the northern parts; so that the natives, with prudence, may always have a plentiful supply of food.

Farming Lands

But perhaps the most important of the undeveloped resources of the country around the bay are its soil, timber and minerals. To the south and south-west of James bay, in the latitude of Devonshire and Cornwall, there is a large tract in which much of the land is good and the climate sufficiently favourable for the successful prosecution of stock and dairy farming. A strip of country along the east side of James bay may also prove available for these purposes. To the south-west of the wide part of the bay the country is well wooded, and, although little or no rock comes to the surface over an immense area, still neither the soil nor the climate are suitable for carrying on agriculture as a principal occupation until we have passed over more than half the distance to Lake Winnipeg. This region, however, appears to offer no engineering difficulties to the construction of a railway from the sea-coast to the better country beyond, and this, at present, is the most important point in regard to it. Some of the timber found in the country which sends its waters into James bay may prove to be of value for export. Among the kinds which it produces may be mentioned white, red and pitch pine, black and white spruce, balsam, larch, white cedar and white birch. The numerous rivers which converge towards the head of James bay offer facilities for "driving" timber to points at which it may be shipped by sea-going vessels.

Minerals

Minerals may, however, become in future the greatest of the resources of the shores of Hudson bay. Little direct search has as yet been made for the valuable minerals of these regions. In 1875 I found a large deposit of rich ironstone on the Mattagami river. (See Geol. Survey Reports for that year.) In 1877 inexhaustible supplies of good manganiferous iron ore were discovered on the islands near the Eastmain coast, and promising quantities of galena around Richmond gulf and also near Little Whale river, where a small amount had previously been known to exist. Traces of

gold, silver, molybdenum and copper were likewise noted on the Eastmain coast. Lignite was met with on the Missinaibi, gypsum on the Moose, and petroleum-bearing limestone on the Abittibi river. Small quantities of anthracite and various ornamental stones, and some rare minerals, were collected in the course of our explorations around the bay. Soapstone is abundant not far from Mosquito bay on the east side, and iron pyrites between Churchill and Marble island on the west. Good building stones, clays and limestones exist on both sides of the bay. A cargo of mica is said to have been taken from Chesterfield inlet to New York, and valuable deposits of plumbago are reported to occur on the north side of Hudson strait. Some capitalists have applied to the Government for mining rights in the latter region.

Hudson Bay a Highway to Europe

Situated in the heart of North America, and possessing a seaport in the very centre of the continent, 1,500 miles nearer than Quebec to the fertile lands of the North-West territories, Hudson bay now begins to possess a new interest not only to Canadians, but also to the people of Great Britain, from the fact that the future highway between the great North-West of the Dominion and Europe may pass through it. The possibility of this route being adopted for trade is not a new idea. It has been frequently suggested by far-seeing men in past years, and occasionally referred to in the newspapers. In 1848, the then Lieut. M. H. Synge, in his work on Canada, wrote: "A ship annually arrives at Fort York for the service of the Hudson's Bay Company; who can tell how many may eventually do so?" The journal of the Statistical Society of London for March, 1864, contains a paper by H. Y. Hind on "The Commercial Progress and Resources of Central British America," in which the writer says: "It is more than probable that whenever the necessity arises, the communication between Winnipeg and Hudson's bay, and thence to the Atlantic, by the aid of steamers, will be made easy and speedy for at least three months in the year." In 1876 Mr. Selwyn brought the subject officially before members of the Canadian Government, and recommended that surveys be made of Hudson bay and strait. In 1878 Col. Dennis published a pamphlet, accompanied by a valuable map, in relation to it. The report of the Minister of the Interior for 1878 contains an appendix by the writer on the practicability of building a railway from Lake Winnipeg to Hudson's bay. During the session of 1878-79, and again the following year, the Hon. Thomas Ryan, a gentleman of great enterprise, brought the matter under the notice of the Dominion Senate.

In 1880 the Parliament of Canada granted charters to two companies for constructing railways and otherwise opening a route for commerce from the North-West Territories to Europe, via Hudson bay, and during the past year one of them, the Nelson Valley Company, caused a survey to be made of a part of the distance between Lake Winnipeg and the harbour of Churchill. Their chief engineer has reported the route, as far as he located the line, to be an easy and inexpensive one for a railway. The directors of the company have again sent an engineering party to the field to carry on the survey during the present year (1881). This company has also the power of connecting with the Canadian Pacific railway in the Saskatchewan region, but the main line is intended to form a connecting link between the great system of inland navigation, which centres in Lake Winnipeg, and the sea. If constructed, the Nelson Valley railway may carry to the seaboard not only the surplus of the grain and cattle of our own North-West, but also that of Minnesota and Dakota. Lieut.-General Sir J. H. Lefroy, President of the Geographical Section of the British Association, in his address at the Swansea meeting (1880), said: "Hudson's Bay itself cannot fail, at no distant day, to challenge more attention. Dr. Bell reports that the land is rising at the rate of five to ten feet in a century, that is, possibly, an inch a year. Not, however, on this account will the hydrographer notice it; but because the natural seaports of that vast interior, now thrown open to settlemen, Keewatin, Manitoba, and other provinces unborn, must be sought there. York Factory, which is nearer Liverpool than New York, has been happily called by Professor H. Y. Hind the Archangel of the West. The mouth of the Churchill, however, although somewhat farther north, offers far superior natural advantages, and may more fitly challenge the title. It will undoubtedly be the future shipping port for the agricultural products of the vast North-West territory, and the route by which immigrants will enter the country." Sir Henry Lefroy, being personally well acquainted with Hudson bay and the North-West territories, may be accepted as a good authority on the subject.

THE HUDSON BAY ROUTE

While the question of the feasibility of navigation of the Hudson bay route for the shipment of grain, cattle and other products is not so important to Ontario as it is to the western prairie Provinces, still if this route can be made into an important commercial highway it will be of great value when railways are extended from the northern part of this Province to James bay, or to Nelson on Hudson bay.

Northern Ontario, which has now a sea coast of over six hundred miles on James bay and the adjacent part of Hudson bay to the westward, possesses vast agricultural resources, great supplies of pulp wood and other timber, and wide mineral areas. The Hudson bay route will, if it proves a commercial success, afford an alternative route to that via the St. Lawrence for the export of our merchandise. Moreover, it will serve as a route by which imports can be brought, at a comparatively low cost for freight, to the province's northern and north-western districts. For instance, the freight on Nova Scotia coal to the James and Hudson bay coast, being all by water, will be low.

Literature on the Route

A compilation of the literature bearing on the Hudson bay route was published in pamphlet form by the Department of the Interior, Ottawa, in 1908.[42] This pamphlet contains an account of the more important observations made up to that time, together with conclusions as to the commercial feasibility of the route. Starting with the earliest period, it is said: " In the course of a century and three-quarters (to 1870), seven hundred and fifty vessels, ranging from seventy-gun ships to ten-ton pinnaces, crossed the ocean, passed through the straits, and sailed the bay in the service of the (Hudson's Bay) Company. And only two were lost. A marvellous record, when it is remembered that all the craft were sailers, and most of them small and of crude construction, and that the bay and strait afforded none of the modern accessories to navigation in the way of coast aids."

The opinions of a number of captains, in the service of the Hudson's Bay Company or in command of whaling ships, are given. Then follow quotations from reports by Dr. Bell, Commander Gordon, who commanded the Neptune expeditions of 1884 and 1885, which were undertaken by the government with the view of ascertaining the actual conditions pertaining to the bay and strait; Commander Wakeham, under whom the Diana expedition of 1897 was despatched for the purpose of making a further test over a longer season, both spring and fall, than those from which Commander Gordon had made his deductions; Lieutenant Schwatka, of the United States Navy, who spent about two years and a quarter in Hudson bay and strait, and adjoining country, and Mr. A. P. Low, who accompanied the expedition of 1897 and commanded the Neptune expedition of 1904-5.

The summing up is as follows:—

"The reports and opinions quoted evidence quite a diversity of view as to the period of safe navigation. Doubtless some are too optimistic, while others are too cautious. But leaving aside the sanguine opinions and considering only the conservative views, the conclusion is clear that Hudson strait and bay afford a safe commercial route to Europe for at least three months in the year, from towards the end of July to about the end of October. It would not be a feasible route compared to that via Montreal, but it would be an adequate subsidiary one—a means of relief from grain blockades such as now endanger the continued development of the west."

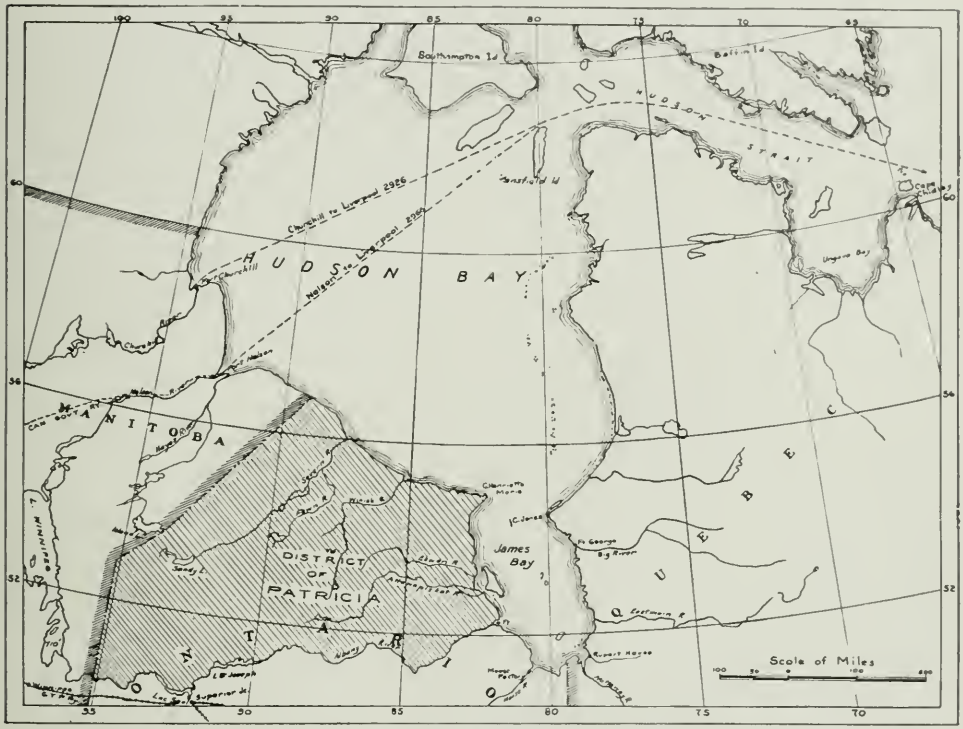
Recent Reports

During the last three or four years, since it has been decided to build a railway to the mouth of the Nelson river, or to Churchill, investigations have been undertaken by the Dominion Department of Railways and Canals concerning the character of the harbours and the navigation of Hudson bay and strait. The results of these investigations are given in the annual reports of the Department.

[42] "The Hudson Bay Route, a compilation of facts with conclusions," by J. A. J. McKenna.

Comparative Distances

From the map on this page it will be seen that the distance from Port Nelson to Liverpool is 2,966 miles; Montreal, via the Strait of Belle Isle, is 2,761 miles, and via Cape Race, 2,927; New York, by the northern route, is 3,079 miles distant from Liverpool. Winnipeg, by the Canadian Pacific railway, is 1,422 miles from Montreal.



District of Patricia and Hudson Bay Route.

Railway Extension

The length of the railway line to be built from the Saskatchewan river, at the Pas station on the Canadian Northern railway, to Port Nelson, is 410 miles.

From the map, scale 35 miles to 1 inch, that accompanies this volume, it will be seen that from Cochrane, the present terminus of the Temiskaming and Northern Ontario railway, to Port Nelson, the railway can be extended in a line continuous with that of the part of the government railway already constructed. It is to be hoped that mineral areas will be found in the more distant parts of older Northern Ontario and in the district of Patricia that will justify the extension of the railway to Port Nelson. The people of Ontario will, in that event, possess a semi-transcontinental railway ending at a seaport.

While the harbours in, at least, the southern part of James bay are poor, it is likely that within a few years they will be utilized as terminals for one or more railways. Examinations are being made of the mouths of the Nottaway and the Rupert, and of the coast of the bay farther to the south and west.

APPENDIX I

Following is the Act passed by the Parliament of Canada in the session of 1911-12, extending the boundaries of the Province of Ontario to include the territory described in the foregoing pages, being Bill No. 152 of the House of Commons for that session:

AN ACT TO EXTEND THE BOUNDARIES OF THE PROVINCE OF ONTARIO

WHEREAS, on the thirteenth day of July, one thousand nine hundred and eight, the House of Commons resolved that the limits of the Province of Ontario should be increased by the extension of the boundaries of the Province so as to include the territory hereinafter described, as in the said resolution is more particularly set out, upon such terms and conditions as may be agreed to by the Legislature of Ontario and by the Parliament of Canada: Therefore, subject to the consent of the said Legislature, His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

1. This Act may be cited as *The Ontario Boundaries Extension Act.*

2. The limits of the Province of Ontario are hereby incresaed so that the boundaries thereof shall include, in addition to the present territory of the said Province, the territory bounded and described as follows:—Commencing at the most northerly point of the westerly boundary of the Province of Ontario, as determined by "The Canada (Ontario) Boundary Act, 1889," chapter 28 of the statutes of 1889 of the United Kingdom, (the said westerly boundary being the easterly boundary of the Province of Manitoba); thence continuing due north along the same meridian to the intersection thereof with the centre of the road allowance on the twelfth base line of the system of Dominion Land Surveys; thence north-easterly in a right line to the most eastern point of Island lake, as shown in approximate latitude 53° 30′ and longitude 93° 40′ on the railway map of the Dominion of Canada, published, on the scale of thirty-five miles to one inch, in the year one thousand nine hundred and eight, by the authority of the Minister of the Interior; thence north-easterly in a right line to the point where the eighty-ninth meridian of west longitude intersects the southern shore of Hudson bay; thence easterly and southerly following the shore of the said bay to the point where the northerly boundary of the Province of Ontario as established under the said Act intersects the shore of James bay; thence westward along the said boundary as established by the said Act to the place of commencement; and all the land embraced by the said description shall, from and after the commencement of this Act, be added to the Province of Ontario, and shall, from and after the said commencement, form and be part of the said Province of Ontario, upon the following terms and conditions and subject to the following provisions:—

(*a*) That the Province of Ontario will recognize the rights of the Indian inhabitants in the territory above described to the same extent, and will obtain surrenders of such rights in the same manner, as the Government of Canada has heretofore recognized such rights and has obtained surrender thereof, and the said Province shall bear and satisfy all charges and exenditure in connection with or arising out of such surrenders;

(*b*) That no such surrender shall be made or obtained except with the approval of the Governor in Council;

(*c*) That the trusteeship of the Indians in the said territory, and the management of any lands now or hereafter reserved for their use, shall remain in the Government of Canada subject to the control of Parliament.

3. This Act shall come into force on a day to be fixed by proclamation of the Governor in Council published in *The Canada Gazette*, but such proclamation shall not be made until after the Legislature of Ontario shall have consented to the increase of the limits of the Province herein provided for, and agreed to the terms, conditions and provisions aforesaid.

Below is given the Act of the Ontario Legislature expressing the consent of the Province to the extension of its limits. It was passed in the session of 1912.

AN ACT TO EXPRESS THE CONSENT OF THE LEGISLATIVE ASSEMBLY OF THE PROVINCE OF ONTARIO TO AN EXTENSION OF THE LIMITS OF THE PROVINCE

His Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:—

1. The Legislative Assembly of the Province of Ontario hereby consents to the Parliament of Canada increasing the limits of the Province of Ontario so that the boundaries thereof shall include in addition to the present territory of the Province the territory bounded and described in the Act of the Parliament of Canada set forth in the Schedule to this Act.

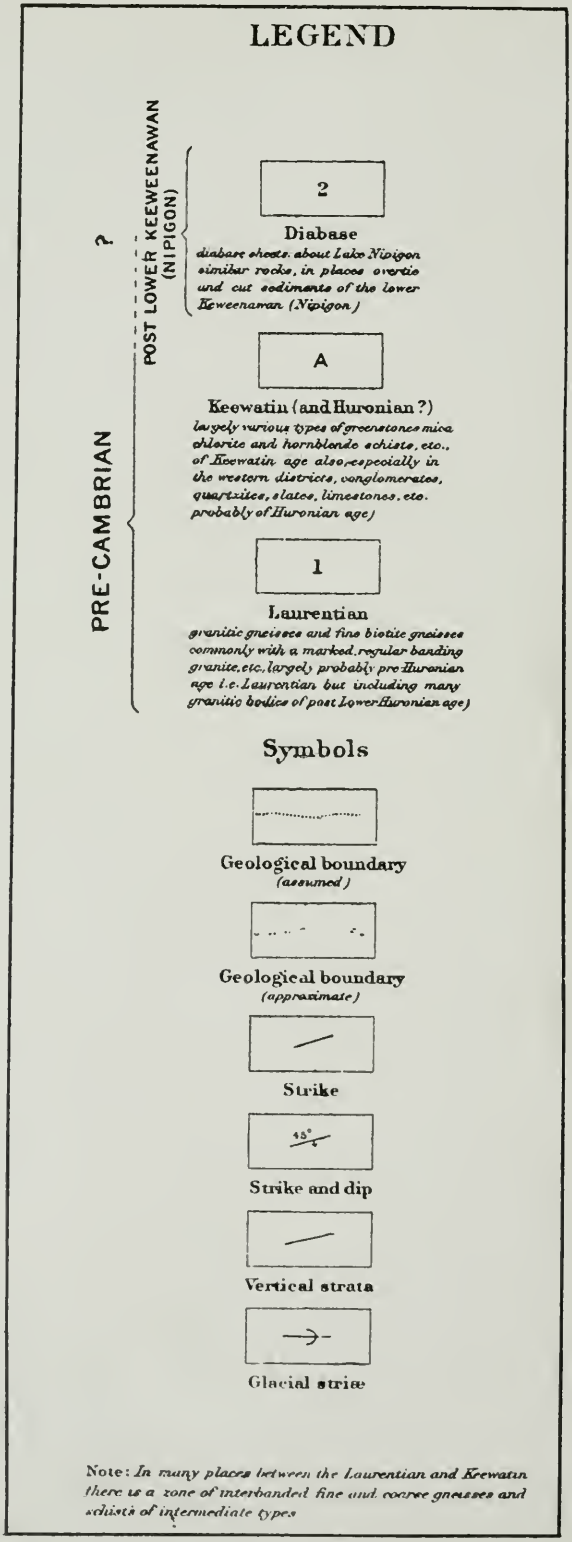
2. The said Legislative Assembly further consents to the Parliament of Canada making provision respecting the effect and operation of such increase of territory in the manner set forth in the said Act.[43]

Harbour and Railway Line

Ontario's strip of territory five miles in width, lying between the district of Patricia and the Nelson river, is to be located within fifty miles of the Hudson bay coast. An additional area, one half mile in width and five miles in length, is to be located along the south shore of the Nelson river. The latter area is to be contiguous to the five mile strip. Together they will afford ten miles of waterfront for harbour facilities and railway terminals.

[43] The schedule repeats Bill 152 of the House of Commons of Canada.

APPENDIX II



Legend showing symbols, and figures and letters indicating rock outcrops, on maps printed on pages of this volume.

INDEX.

DEPARTMENT OF LANDS, FORESTS AND MINES
BUREAU OF MINES

MAP
— OF THE
DISTRICT OF PATRICIA
PROVINCE OF ONTARIO

To accompany Part II, Volume 21, Report of Bureau of Mines, 1912

Hon. W. H. Hearst, *Minister.* Willet G. Miller, *Provincial Geologist.*

Scale: 1 in. = 35 miles or 35 Miles 1 inch

25 0 25 50 75 100 Miles

SOURCES OF INFORMATION —

Railway Map of Canada issued by the Department of the Interior, Ottawa, 1912.

Maps issued by the Geological Survey of Canada.

NOTES:—

The territory now called the District of Patricia was added to the Province of Ontario by Act of Parliament of Canada (2 George V, Chapter 40, Statutes, 1912); and consented to by the Legislative Assembly of the Province of Ontario (2 George V, Chapter 3, Statutes 1912).

Ontario's strip of territory five miles in width, lying between the District of Patricia and the Nelson river, is to be located within 30 miles of the Hudson Bay coast. An additional area one half mile in width and five miles in length is to be located along the south shore of the Nelson river. The latter area is to be contiguous to the five mile strip. Together they will afford 10 miles of waterfront for harbour facilities and railway terminals.


DISTRICT
OF
PATRICIA
ONTARIO
JAMES
BAY
LAKE
SUPERIOR
MINNESOTA
INTERNATIONAL BOUNDARY
LAKE NIPIGON
Port Arthur
Fort William
Sault Ste. Marie
Longitude West 87 from Greenwich 86 85 84 83 82 81 80 79 78

Notes

Elevations of lakes above sea level were taken from C.N.O. Ry. plans.

The canoe route from Ruel station to West Shiningtree lake was improved during the winter of 1911-12 by the construction of two dams on the Opickinimika river. These are situated in the townships of Miramichi and Garibaldi, and their position is indicated on the map.

Compass lines showing timber berth boundaries in the township of Shelly are shown in approximate position.

Signs

— —	*Height of Land.*
Por Por	*Portage.*
	Hill.
	C.N.O.Ry. constructed.
	Winter Road.
R	*Rapid.*
1289'	*Elevation above Sea Level*

MAP
OF THE
WEST SHININGTREE AREA
DISTRICT OF SUDBURY

SHOWING ROUTE FROM CANADIAN NORTHERN ONTARIO RAILWAY

TO ACCOMPANY REPORT OF R. B. STEWART IN THE TWENTY FIRST REPORT OF THE BUREAU OF MINES, ONTARIO, 1912.

HON. W. H. HEARST, *Minister of Lands, Forests and Mines.*
WILLET G. MILLER, *Provincial Geologist.*

SCALE : $\frac{1}{126{,}720}$ or 2 Miles = 1 Inch.

1 ½ 0 2 4 Miles.

Mining Locations

A. Gosselin	*W. D. 1151, 1157*
Moore & McDonald	*W. D. 1163, 1164*
Clark	*W. D. 1166*
S. Jepson	*W. D. 1173*
G. Bennett	*W. D. 1406*

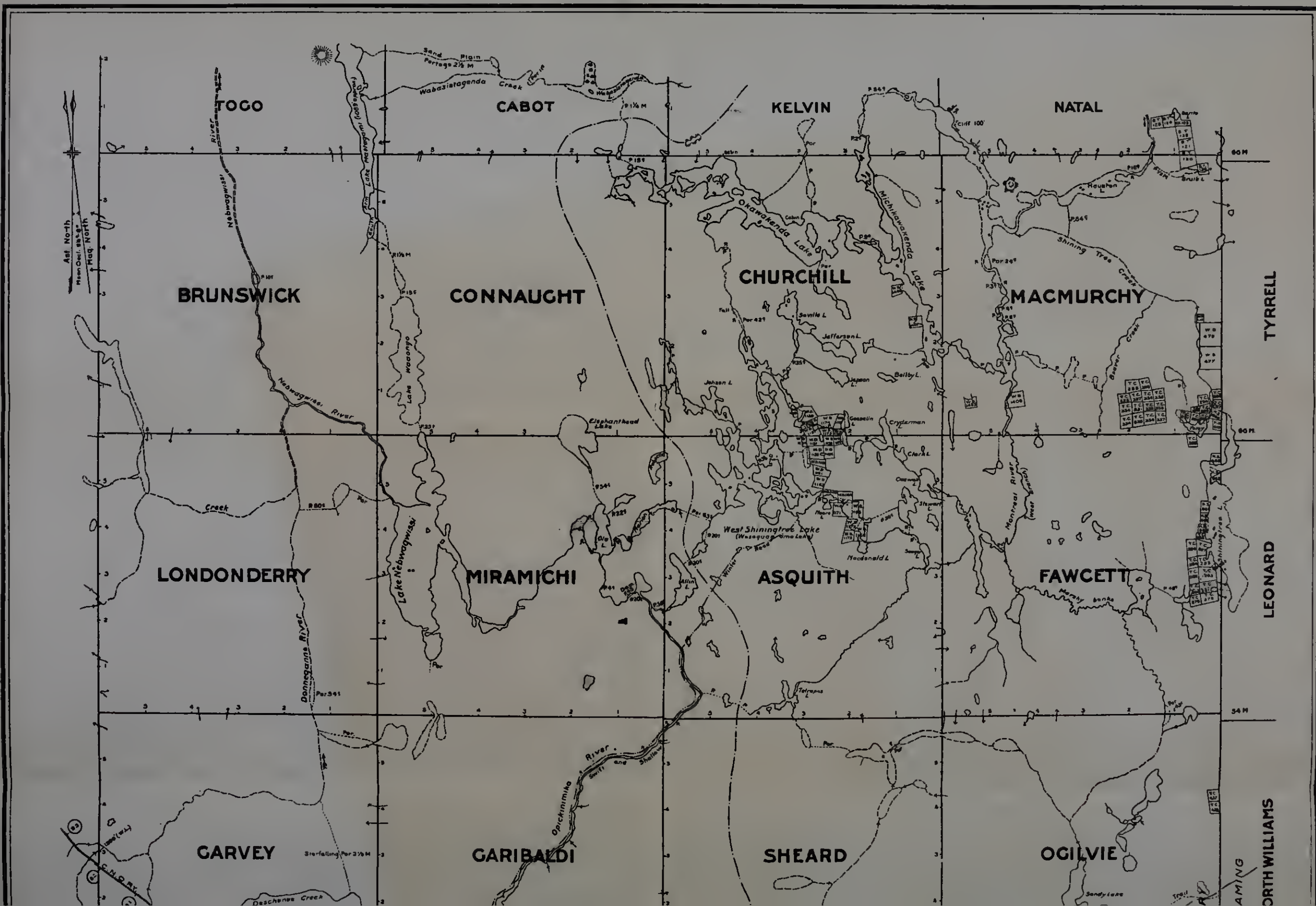
Sources of Information

Township outlines from Department of Lands, Forests and Mines, Surveys Branch.

Canadian Northern Ontario Railway Surveys.

Traverses of Okawakenda and Michikawakenda lakes and Opickinimika river by W. R. ROGERS.

Advance photographic map of West Shiningtree, also traverses except as above noted by W. H. Collins, Geological Survey of Canada.




GARVEY
GARIBALDI
SHEARD
OGILVIE
NORTH WILLIAMS
DISTRICT OF TEMISKAMING
DISTRICT OF SUDBURY
DUFFERIN
HENNESSY
MOFFAT
AMYOT
BROWNING
HEIGHT OF LAND
BLEWETT
BEULAH
HODGETTS
UNWIN
STULL
SHELLY
MARSHAY
LAMPMAN
LEASK
VALIN
ONAPING
SCOTIA
FRECHETTE
McNAMARA

ONTARIO
DEPARTMENT OF LANDS, FORESTS & MINES

GEOLOGICAL SKETCH MAP
OF THE
CRIPPLE CREEK AREA
DISTRICT OF TEMISKAMING

To accompany Report by W.R. Rogers and E.L. Bruce, in the Twenty First Report of the Bureau of Mines, 1912.
Hon. W. Hearst, Minister of Lands, Forests and Mines. Willet G. Miller, Provincial Geologist.

Scale: 1 Mile to an Inch.

MASSEY — TURNBULL

Base line run by G.S. Nimmo, 1909

LEGEND
- Diabase
- Grey Granite
- Red Granite
- Keewatin

NOTE: The elevations of lakes on the south boundary of Keefer and Denton are from T. and N.O.Ry. surveys. Other elevations noted on the map are aneroid and hand level determinations.

Whitesides. Carscallen. Keefer. Denton.

MANISKOTIA RIVER
CRIPPLE CREEK
LOST OR REDDUCKER RIVER
BRISTOL
THORNELOE
HILLARY
REYNOLDS

Map No 218

MAP
SHOWING
GOLD AREA
IN THE TOWNSHIPS OF
MUNRO AND GUIBORD
DISTRICT OF TEMISKAMING
ONTARIO

To accompany Report of A.G. Burrows, in the Twenty First Report of the Bureau of Mines, 1912.

Scale: 1/63,360 = 1 Mile to an inch.

Map No 21c

LEGEND

DIABASE

TEMISKAMING
Greywacké and slate.

KEEWATIN
Amygdaloidal greenstone, serpentine, old diabase, graphitic schists, iron formation, and rusty carbonate.

Swamp.
Hill.
Road.
Trail.

NOTES

The Munro-Guibord gold area lies nine miles east of the town of Matheson, mileage 205 on the Temiskaming and Northern Ontario railway. A good waggon road connects the mining camp with the railway. The locality was geologically examined in August, 1911.

Claims were first staked for gold in 1908 and since that time some development work has been done. The active mining claims are located along the south boundary of Munro, being partly in Munro and partly in Guibord.

The rocky portions of Munro, which occupy a considerable part of the west half of the township, have been burned over in recent years, so that prospecting has been facilitated. The eastern part is made up largely of rolling sand ridges with occasional swamps.

Three series of rocks occur in the area, namely, an old igneous complex, the Keewatin, an old sedimentary series, the Temiskaming, and a series of later intrusives. An ellipsoidal basalt is the most widely distributed Keewatin eruptive. At times amygdules are abundant, giving the rock a conglomeratic appearance. Some light-coloured felsitic dikes cut the greenstone. Other Keewatin rocks are serpentine and iron formation. The Temiskaming series occurs as a narrow belt in the southwesterly part of Munro and the adjoining part of Guibord. It consists of rather coarse greywacké and finely banded clay rocks, which have been considerably altered to quartzite, slates and schists. In one locality the series is intruded by a narrow dike of grey feldspar-porphyry. The later intrusives are quartz-diabase and gabbro. Under the microscope these rocks greatly resemble the diabase from the sill at Cobalt. A gabbro-like rock occurs in large volume on the north part of Munro, and as a high conical hill in the third concession of Guibord.

QUARTZ VEINS.—The gold-bearing veins which are being worked are in the sedimentary rocks of the Temiskaming series. They are often quite regular and traceable over several hundred feet. Their strike is, for the most part, nearly East and West. As at Porcupine the veins have been considerably disturbed, showing several generations of quartz. Iron pyrites is the chief sulphide, and galena occurs in small quantity. Visible gold was noted in the quartz in several veins.

The first operations were at the Munro mines, where a shaft was sunk 92 feet and some drifting done at the 60-foot level. The greatest development has taken place at the Detroit-New Ontario mine, where a 9 x 7 shaft has been sunk 100 feet and 200 feet of drifting and cross-cutting on three narrow veins accomplished. The main vein at this property dips 80° S. A small prospecting stamp mill was in operation and some bullion has been produced.

At the Gold Pyramid mine, in Guibord township, there are two prominent quartz veins. On the southerly of these the development work consisted of a shallow shaft and open cut, with some trenching in deep soil to the south. This vein has been exposed for about 250 feet. The northerly vein had been traced for 400 feet and a shaft was being sunk on it. A 5-stamp mill was being erected on this property.

MAP OF THE SWASTIKA GOLD AREA DISTRICT OF TEMISKAMING — ONTARIO —

To accompany Report by E. L. Bruce in the Twenty-First Report of the Bureau of Mines, 1912.

Hon. W. H. Hearst, *Minister of Lands, Forests and Mines.* Willet G. Miller, *Provincial Geologist.*

Scale: 31.680 = 40 Chains to an Inch

Chains 80 60 40 20 0 1 2 Miles

MINING LOCATIONS

Swastika Mining Co., R.S.C. 204, 205.
N½ Lot 9, Con. VI, Otto.
Lucky Cross . . . T.C. 57, 58, 59.
Homestead . . . R.S.C. 209, 210.

NOTES

KEEWATIN.—The oldest rocks of the Swastika area are greenstones. In places these rocks are altered to schists or are serpentinized. They sometimes, however, show their original basaltic texture, and an ellipsoidal structure is occasionally seen. Associated with the greenstones and schists are a few bands of iron formation and also a well-banded epidote rock.

On the north side of the Keewatin belt the strike of the schists averages N.E., and the dip 70° N.W. Farther south the schists are lying flat. On the south side the strike is W. 64° E. and the dip is 80° S.E.

Cutting the greenstones and schists is a grey feldspar porphyry consisting of feldspar phenocrysts in a groundmass of quartz, feldspar and sometimes hornblende. Occasionally the hornblende is lacking, and the rock consists entirely of quartz and albite. An area of hornblendite also occurs. This rock is composed of large phenocrysts of hornblende in a fine grained basic groundmass. It is intrusive into the Keewatin schists and greenstones.

LAURENTIAN.—The Laurentian of the area is made up chiefly of syenitic rocks. These are often very coarse grained with feldspar crystals up to an inch in diameter. The hornblendite mentioned previously may be a basic segregation from the syenite magma.

HURONIAN.—The Huronian consists of conglomerate and greywacké. The pebbles are greenstone and porphyry with an occasional piece of granite. A striking feature is the large number of fragments of jasper often of considerable size. Albite very similar to that of the grey feldspar-porphyry is found in the greywacke. Near the Keewatin the Huronian is squeezed and altered, a band of carbonate rock often separating typical Huronian from typical Keewatin. This alteration may possibly be due to post-Huronian faulting. In parts of the area, the relation of the rocks classed as Laurentian to the Huronian is doubtful. In other parts conglomerate overlies the syenite and includes pebbles of it. There may therefore be two series of Huronian rocks, viz., one older than the syenite and the other younger.

POST-HURONIAN.—Two series of dikes are clearly intrusive into the conglomerate and greywacke. One of these is a red granitoid rock consisting largely of a high soda feldspar. It cuts the Huronian, sending out tongues into the sedimentary rock.

The other post-Huronian intrusive is basic in character. It consists of phenocrysts of augite in a groundmass of augite and feldspar needles. It shows in places a pseudo-amygdaloidal texture and weathers with a pitted surface.

These two dike rocks were not found in contact with each other.

DIABASE.—The Keewatin is cut by numerous dikes of diabase, some of which may be post-Huronian. Many of them, however, are considerably altered, and none were found cutting conglomerate or greywacké.

LEGEND

GLACIAL AND RECENT
Drift.

DIABASE
Dikes of diabase intrude the Keewatin. These may be post-Huronian or older.

POST-HURONIAN
Augite lamprophyre, red and dark-grey porphyry.

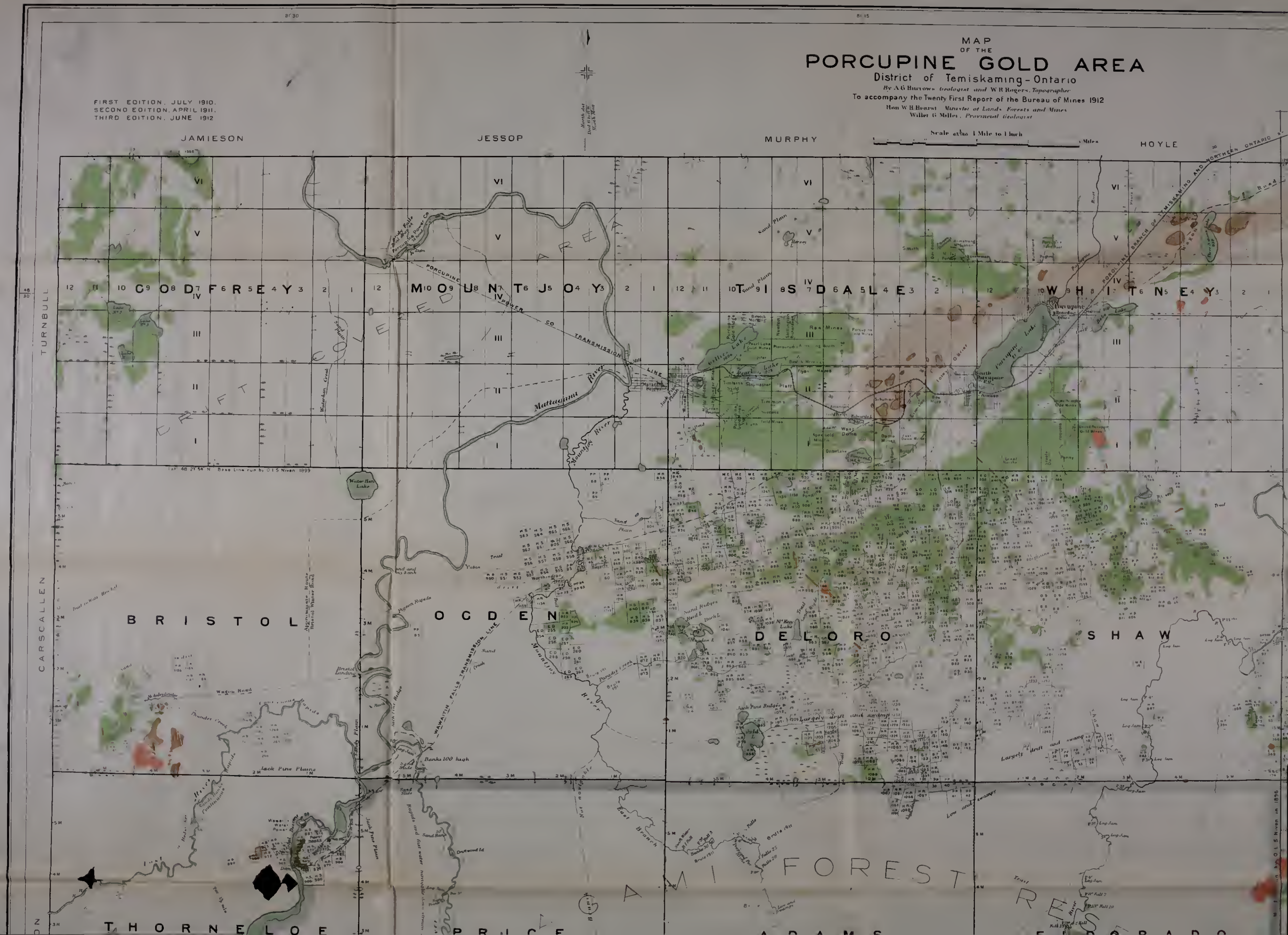
HURONIAN SYSTEM
Conglomerate and greywacké. Two series of conglomerate, Temiskaming and Cobalt, may be included in the Huronian, though no unconformity was seen.

LAURENTIAN SYSTEM
Syenite and other acid rocks. Part may intrude the Huronian.

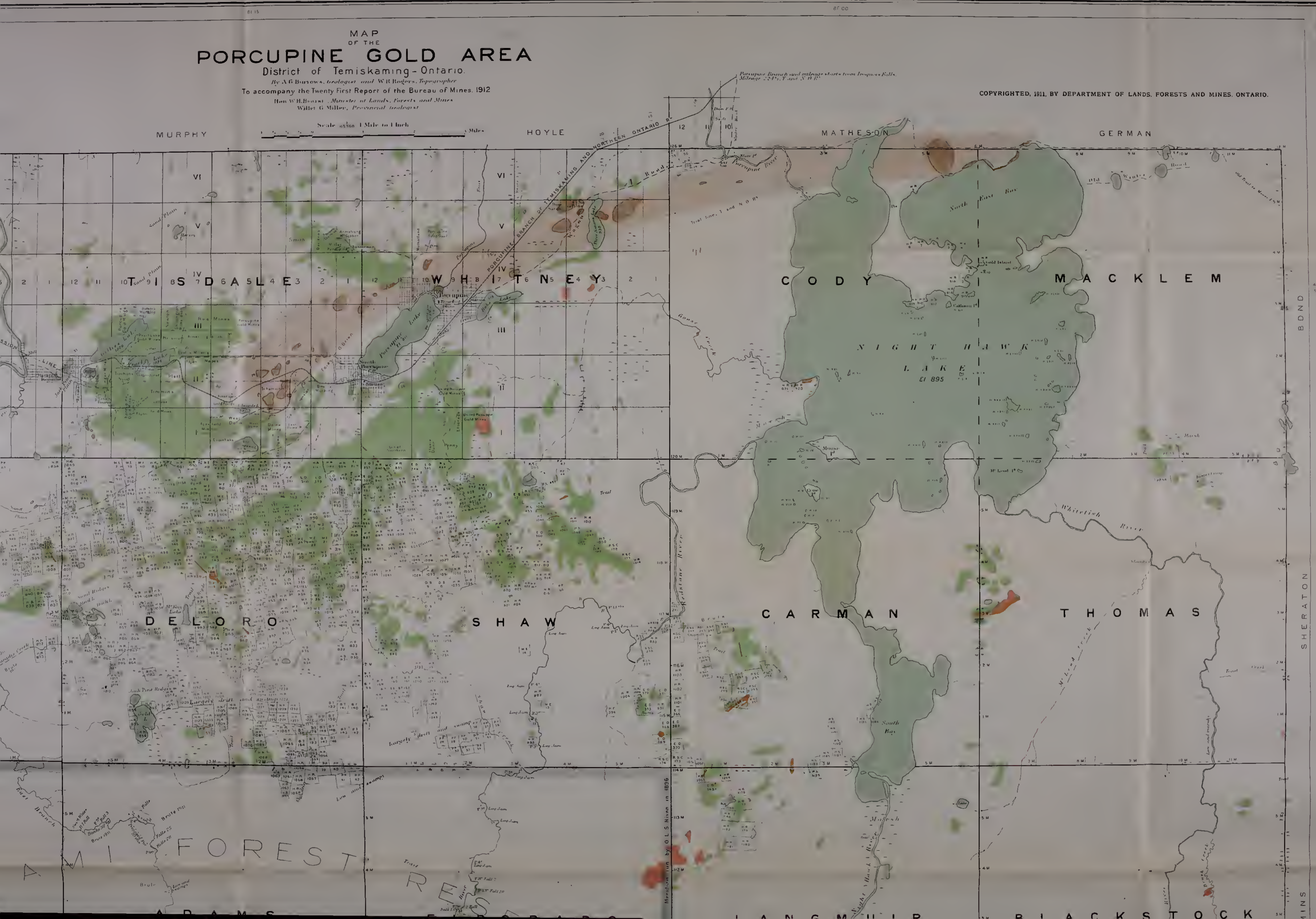
KEEWATIN SYSTEM
Greenstone, basalt and iron formation.
Grey feldspar-porphyry.

Trail.
Road.
Hill.
Swamp.
Miles by stage Dane to Larder L.

GRENFELL
TECK
LEBEL
BOSTON
OTTO
EBY
Perron Lake
Eksie Lake
Pike Lake
Otto Lake
Portage
Blanche River
Blanche
Ballast Pit
Kenogami Sta. El. 1013
Dane Sta. El. 1035
Outlet Gull Lake
Hornblendite
Temiskaming and Northern Ontario Railway
To Round Lake
Spur to Ballast Pit
T. & N. O. Ry
Commission
Compilation by W. R. ROGERS, Topographer
Map No. 21b



MAP OF THE
PORCUPINE GOLD AREA
District of Temiskaming - Ontario
By A G Burrows Geologist and W R Rogers, Topographer
To accompany the Twenty First Report of the Bureau of Mines 1912
Hon W H Hearst Minister of Lands Forests and Mines
Willet G Miller, Provincial Geologist
FIRST EDITION, JULY 1910.
SECOND EDITION, APRIL 1911.
THIRD EDITION, JUNE 1912
Scale 1 Mile to 1 Inch
Miles
JAMIESON
JESSOP
MURPHY
HOYLE
TURNBULL
CARSCALLEN
GODFREY
MOUNTJOY
TISDALE
WHITNEY
BRISTOL
OGDEN
DELORO
SHAW
THORNELOE
PRICE
ADAMS
FOREST
PORCUPINE POWER CO TRANSMISSION LINE
WAWAITIN FALLS TRANSMISSION LINE
TEMISKAMING AND NORTHERN ONTARIO
PORCUPINE BRANCH OF
Mattagami River
Mountjoy River
Porcupine Lake
Pearl Lake
Gillies Lake
Water Hen Lake
Bristol Landing
Jack Pine Plains
Banks 100 high
Sand Plain
Porcupine
South Porcupine
Timmins
Dome Mines
Largely drift and swampy
Low and swampy
East Branch
Wagon Road
Trail


MAP
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Willet G Miller, Provincial Geologist
Scale 1 Mile to 1 Inch
Miles
COPYRIGHTED, 1911, BY DEPARTMENT OF LANDS, FORESTS AND MINES, ONTARIO.
MURPHY
HOYLE
MATHESON
GERMAN
TISDALE
WHITNEY
CODY
MACKLEM
DELORO
SHAW
CARMAN
THOMAS
NIGHT HAWK LAKE
El 895
TEMISKAMING AND NORTHERN ONTARIO RY
PORCUPINE BRANCH OF TEMISKAMING AND NORTHERN ONTARIO RY
South East Bay
South Bay
Whitefish River
BOND
SHERATON
LANGMUIR
BLACKSTOCK
ADAMS
FOREST RESERVE

NOTES

By A. G. BURROWS

TWO editions of this map have been published, the first being based on field work during May and June, 1910. The second edition was the result of a more extended examination during the remainder of the season of 1910. During 1911 further field work was done and mining locations which were not surveyed the previous year were mapped. In addition several other areas beyond the confines of this map were examined. These included the Munro and Guibord gold area, the Swastika area; an area to the southwest of Porcupine, including Denton, Carscallen, Whitesides and Keefer, and the township of McArthur directly south of Porcupine. Geological maps of these areas, together with the third edition of the Porcupine map, have been prepared and accompany the Bureau of Mines Report, Volume 21.

In the unsubdivided townships mining location surveys have been utilized in mapping geological boundaries. Several of these surveys have been made since the field work was finished, and in consequence it may be found that the geological boundaries do not conform properly to some recently surveyed lines. However, it is believed that most of the rock outcrops immediately around Porcupine have been shown.

HISTORY OF DISCOVERIES

Until the last two or three years the Porcupine area was difficult of access and little prospecting was done in it. The information concerning it was practically all contained in the reports published by the geologists who accompanied O. L. S. Niven in his base-line work and the township surveyors in the years 1896, 1898, 1899, 1903, 1904 and 1905. In 1896, Mr E. M. Burwash accompanied Mr. Niven as geologist in the survey of the Nipissing-Algoma boundary line, which, it may be added, now forms the boundary between the districts of Nipissing and Sudbury. The boundary was run northward to mile 120, which is now situated at the southeast corner of the township of Whitney, and the eastern boundary of the township of Shaw includes that part of the line lying between mile 114 and mile 120. Mr. Burwash's description is published in Volume 6 of the Report of the Bureau of Mines. He points out that the district gives promise as a gold-field. The following extracts are taken from his report, pages 180, 181 and 183:—"Near the 118th mile the line finally passes off the granite and intrudes upon grey slate rocks. On the first half of the 116th mile (now on the eastern boundary of the township of Shaw) a small quartz vein occurs which, on assay, was found to contain a trace of gold . . . The district would be a promising one from the prospector's point of view were it not for the presence of the drift . . . . In the lower parts of the series [Keewatin], on the other hand, gold appears to be quite widely distributed, both in veins which are of tolerably frequent occurrence and in mineralized portions of the rock itself . . . . In two cases the veins were situated near the boundary of granite areas. In two localities, between the 85th and 95th miles, the gold occurs in mineralized bands of the country rock, which in both cases is more or less chloritic."

In 1898 Mr. W. A. Parks reported on the geology of the district for the Bureau of Mines. His paper is published in Volume 8. Mr. Parks noted the occurrence of gold in traces in some of the quartz veins, and said:—"I regard the region south of the trail to Porcupine lake as giving promise of reward to the prospector." Interesting reports on the district including or adjacent to Porcupine were later made for the Bureau of Mines by Mr. Geo F. Kay, Mr James G McMillan and Mr H L Kerr, whose reports are published in Volumes 13, 14 and 15 respectively of the Bureau of Mines.

The first prospecting in the area appears to have been done in 1906, when a shallow pit was sunk on a claim adjacent to what is now known as the Hollinger mine. The next work in the area was done by Mr. H. F. Hunter on the northeastern shore of Porcupine lake. The vein uncovered here shows gold in hand specimens. In 1909, interest was revived in the district by the discoveries of Mr. J. S Wilson and others. Mr. James Bartlett, one of the Bureau's geologists, made a brief examination of the discoveries in October, and a report by him was shortly afterwards made public.

ROUTE TO PORCUPINE

During 1911 the Ontario Government constructed a branch railway into Porcupine. This line leaves the main line of the Temiskaming and Northern Ontario railway at Mileage 224½, now known as Iroquois Falls. This branch line [illegible] gradually extended to Timmins townsite, which will be the terminus for some time, being at the western edge of the main gold mining area. The distance from Toronto to Timmins by rail is 485 miles.

TOPOGRAPHY

Much of the surface of the area is low and wet, although it can scarcely be said to be swampy. The lower flat surface is occupied by well-banded clay, together with some sand and gravel. Overlying the clay is a layer of vegetable mould from a few inches to a foot or more in thickness. This layer holds water, the underlying clay being impervious, and presents a surface somewhat difficult to drain. Outcrops of compact rock occur irregularly over the surface covering. Since some of them are small, they are difficult to locate. In some sections of the area the rocks rise into ridges which extend across parts of several lots. In most cases their height above the general level is not more than 50 feet. Occasionally it is 100 to 150 feet.

The area lying between the mouth of Porcupine river and Porcupine lake has a maximum elevation of about 970 feet. The southwestern part of Tisdale is considerably higher, the hill behind the Hollinger clubhouse, for instance, reaching an elevation of 1157 feet above sea level.

In the area embraced by the map the greatest relief is about 525 feet. This difference in elevation occurs between the Mattagami River and a prominent hill 2½ miles distant on the north boundary of the township of Godfrey.

The lakes are shallow, Night Hawk lake having a depth of only 6 feet in many parts. The greatest depth of water found in Porcupine lake was 20 feet.

GEOLOGY

The legend of the map gives the age groups of the rocks which have been recognized in the field.

KEEWATIN.—The oldest series, the Keewatin, is similar in character to rocks of this age found in various parts of northern Ontario, from the Quebec boundary on the east to that of Manitoba on the west. It consists of various volcanic rocks with their schistose representatives. The series is here much more disturbed, as is illustrated by the schistose character in many places, than it is in the Cobalt area. In the Porcupine area, however, some of the Keewatin rocks have escaped dynamic metamorphic agencies sufficient to show their original character. In parts of the township of Whitney and elsewhere, for instance, certain basalts still retain quite perfectly their amygdaloidal texture and ellipsoidal structure. Most of the Keewatin in the Porcupine area, as elsewhere, consists of dark-coloured or greenish, massive or schistose rocks of basic or intermediate composition. Quartz-porphyry is, however, a rather common rock in the Porcupine area. While it occurs characteristically in dikes, cutting green schists, it is also found in larger masses. Certain quartz-porphyry dikes have been subjected to pressure and broken up, and now resemble conglomerate. The metamorphic action has produced a dark greenish base through which are set fragments of the porphyry. Probably volcanic fragmental rocks of Keewatin age occur in the area, but they have not been definitely recognized.

Associated with the Keewatin, especially in the southern part of the township of Whitney, there is much iron formation. This iron formation is what is commonly called jaspilyte, and consists of alternate thin bands of magnetite and silica, the latter being frequently red in colour. Many of the Keewatin rocks contain considerable carbonate—calcite, dolomite or a ferruginous carbonate. In some parts of the area are masses of rocks essentially composed of these minerals, giving rise to crystalline limestone which is usually rusty-weathering. Such an occurrence is found on the northern part of lot 10 in the sixth concession of Whitney township. This outcrop covers an area of 12 to 15 acres and is not seen in contact with other rocks. It may correspond in age to the crystalline limestone of the Grenville series of eastern Ontario. In the vicinity of the Dome mine there is an outcrop of a ferruginous carbonate. It would appear not unlikely that carbonate in some places is a replacement mineral, and that a considerable volume of rock may at times have been replaced by the carbonate. A ferruginous

LEGEND

GLACIAL AND RECENT

The uncoloured areas are largely drift covered, and consist of boulder clay, stratified clay, sand, etc.

Pre-Cambrian

LATER INTRUSIVES

Quartz-diabase, olivine diabase, and other later dikes.

IGNEOUS CONTACT

COBALT SERIES

Conglomerate.

UNCONFORMITY

TEMISKAMING SERIES

Conglomerate, quartzite, greywacké, slate or delicately banded greywacké

UNCONFORMITY

LAURENTIAN SYSTEM

A complex of granites older than the Cobalt series. It intrudes the Keewatin, but its relationship to the Temiskaming is not definitely known; it may be in part older and in part younger than the Temiskaming series.

LEGEND—

KEEWATIN SYSTEM

SIGNS

Swamp.

F Fall.

P or Por Portage.

Hill.

Trail.

Road.

LEGEND

GLACIAL AND RECENT

The uncoloured areas are largely drift covered, and consist of boulder clay, stratified clay, sand, etc.

Pre-Cambrian

LATER INTRUSIVES

Quartz-diabase, nitrose diabase, and other later dykes.

IGNEOUS CONTACT

COBALT SERIES

Conglomerate

UNCONFORMITY

TEMISKAMING SERIES

Conglomerate, quartzite, greywacke, slate or detrivally banded greywacke

UNCONFORMITY

LAURENTIAN SYSTEM

A complex of gneisses older than the Cobalt series. It intrudes the Keewatin, but its relationship to the Temiskaming is not definitely known; it may be on part older and on part younger than the Temiskaming series.

LEGEND—(Continued)

IGNEOUS CONTACT

KEEWATIN SYSTEM

The series consists chiefly of basic to acid volcanic rocks, much decomposed, and generally schistose. Sediments are uncommon. Augi-doleidal basalt, serpentine, diabase, quartz or feldspar-porphyry, banded iron formation, and rusty weathering carbonate rocks have been recognized.

SIGNS

- *Swamp.*
- F. *Fall.*
- P or Por. *Portage.*
- R. *Rapid.*
- *Hill.*
- *Trail.*
- *Road.*
- 925 *Elevation above Sea Level.*
- *Temiskaming & Northern Ontario Ry.*
- *Porcupine Power Co. Transmission Line.*
- *Wawaitin " " " "*

NOTES—(Continued)

carbonate, not unlike that in rock masses, occurs as veinstone in a few cases. For instance, the strong vein on the West Dome and adjacent claim is composed of a ferruginous carbonate that has been fractured and filled in with quartz; an analysis of this carbonate shows it to have the following composition: Ca O, 26.68%; Mg O, 14.20%; Fe O, 8.06%; C O$_2$, 43.14%. A somewhat similar carbonate occurs in a vein on the Hollinger Reserve in the township of Ogden and an analysis shows its composition to be: Ca O, 23.97%; Mg O, 6.46%; Fe O, 10.39%; C O$_2$, 34.94%.

LAURENTIAN.—About 10 miles to the southeast of Porcupine outcrops of horublende granite are frequently seen. This granite intrudes the Keewatin. In a patch of conglomerate of the Cobalt series on the south line of Langmuir township, pebbles of hornblende granite occur, proving that some of the granites are pre-Cobalt series in age. A somewhat fine grained, biotite gneiss, occurring sparingly in the southern part of Whitney township, intrudes the Keewatin series, but its relation to the Temiskaming has not been determined.

Two series of pre-Cambrian sedimentary rocks occur which are later than the Keewatin:

(1) Temiskaming Series.—A series of sediments, which have been subjected to great metamorphism and are now highly inclined

(2) Cobalt Series.—A series of sediments, which are little disturbed, corresponding to the Cobalt series in the Cobalt area.

(1) Temiskaming Series.—A belt of fragmental rocks that outcrops through the drift at irregular intervals has been traced from near the mouth of the Porcupine river, in the township of Cody, southwest across the northern part of Whitney and southwest through Tisdale to the Dome mine. In order to show the probable limits of this belt a tint has been used, whereas the outcrops are shown in full colour. Similar rock outcrops on the northeast bay of Night Hawk lake, and also southwest of Porcupine in the township of Bristol, and around Wawaitin falls. The Temiskaming series has been subjected to considerable metamorphism, often being altered to schists which are with difficulty distinguished from Keewatin schists. Where dynamic metamorphism has taken place, one of the most difficult problems of the pre-Cambrian is to distinguish true fragmental, especially conglomeratic, from volcanic fragmental material, or from friction breccias which are commonly called autoclastic rocks. In some areas doubtless each of these three classes—(1) true conglomerates, (2) volcanic fragmental material, (3) friction breccias or autoclastic rocks, may be present. Then the pre-Cambrian geologist may be excused if he makes a mistake.

In parts of the area different facies of the series are well represented, showing a succession of conglomerate, impure quartzite or more massive greywacke, and slate or well-banded greywacke. Where the Temiskaming has been rendered schistose its recognition is assisted by the occurrence of these facies. It is difficult in some cases, as has been said above, to distinguish metamorphic conglomerate from volcanic fragmental or autoclastic rocks, but the more slate-like facies of the Temiskaming series tends to retain its original character more perfectly and is less apt to be mistaken for, or confused with, Keewatin rocks.

This series is distinguished from the Cobalt series not only by the steeply inclined position of the beds, but also by a marked secondary cleavage, often developed across the bedding planes, which as not seen in the later series. It is also marked by the presence of considerable conglomerate.

(2) Cobalt Series.—This series occurs only in small volume, being represented by a flat-lying conglomerate on the south boundary of Langmuir township in the southeastern corner of the area. The conglomerate contains numerous boulders of reddish granite and rests unconformably on a Keewatin floor.

Of these two series the Temiskaming only is of economic importance, the Cobalt series being of later age than the gold-bearing veins.

Later Intrusives.—Several dikes of olivine diabase and other basic rocks, cutting the Keewatin, have been found in the area. Some of these dikes are similar in character to the well-known dikes of Sudbury and to one or two that have been found in the Cobalt and Gowganda areas. The olivine diabase in the Porcupine area is considered to be younger than the Cobalt series.

Glacial and Recent Deposits.—It is not necessary to say more concerning the glacial and recent deposits of the district than has been said in previous parts of these notes.

ORE BODIES

Outcrops of quartz are very numerous in the area mapped. They are found in rocks of both Keewatin and Temiskaming age. The age of the rock, whether Keewatin or Temiskaming, does not appear to have any bearing on the character of the vein, either as to form or as to gold content.

The writer has little doubt that the quartz deposits of the Porcupine area are connected with the great granite intrusions which took place in post-Temiskaming times. The quartz has been deposited from the impure waters, highly heated and under great pressure, which worked through the rocks after the granite intrusion. Some of the quartz veins give evidence of their granite relation to granite intrusives, *e.g.* feldspar is seen in certain veins and the occurrence of tourmaline and gas bubbles in the quartz is corroborative evidence. Specimens having the composition of granite are to be found in a few veins which carry visible gold (Miller-Middleton).

There is a great variety of forms assumed by the quartz bodies. Sometimes they occur as well defined veins having great length as compared to width. As example of these may be taken the veins in the vicinity of Pearl lake. The No. 1 vein of the Hollinger group has been exposed for over 1,000 feet on the 100 foot level. By the term "vein" is not meant a solid body of quartz over this whole length. In parts of the ore body quartz fills the drift from wall to wall and occasionally is still broader, but in other parts there are numerous narrow stringers of quartz cutting the schistose rock. These broad quartz bodies and intersecting portions of narrow stringers and schist constitute the vein, and as a workable body are quite linear in character. Quartz masses having a width up to 100 feet are occasionally seen. These are portions of broad lenticular masses which are on their strike. The harder and more resistant quartz has withstood erosion better than the schist and now shows as dome-like masses. The best examples of domes occur at the Dome mine. Sometimes the ore body is very broad. At the Dome mine the ore body, consisting of quartz stringers, narrow quartz veins and pyritous schist, has a width in one place of 250 feet.

A deposit distinct in character from those as the quartz schistose vein on the West Dome. Here the mass of the vein is schistose, while the quartz occurs as narrow veinlets mostly transverse to the vein. At one point the schistose vein is 35 feet wide.

Where the rocks are not extremely schistose, as around Three Nations lake, the quartz veins, which are very narrow, have a regular character unlike the lenticular veins of the highly schistose areas. Similar narrow veins occur in the quartz-porphyry area south of the Dome.

The schistose rock along the veins is often impregnated with iron pyrites, and in most cases part of the walls will be mined and treated with the vein material. In general the larger lenticular veins of the area are approximately parallel to the strike of the embracing schists, whereas the narrower, better defined veins generally show a strike quite different from the enclosing rock.

An examination of veins in the field and of thin sections of quartz under the microscope shows that the original quartz of the veins has been fractured and a great part of the gold deposited from solutions which circulated in the minute fissures and crushed areas of the quartz and enclosing rock. Crushed portions of veins are often indicated by dark streaks or patches in the quartz. Pyrite, calcite, sericite, chlorite, quartz and tourmaline frequently occur in the fractured areas. Often the later quartz has a bluish colour. These minerals are sometimes arranged in a parallel manner giving a banded character to the ore.

The following minerals occur in veins in different parts of the area:—Quartz, sulcrite, calcite, sericite, chlorite, feldspar, tourmaline, scheelite, pyrite, pyrrhotite, copper pyrites, galena, nickeliferous arsenopyrite and bornite.